ERDC/EL SR-09-1

Environmental Laboratory

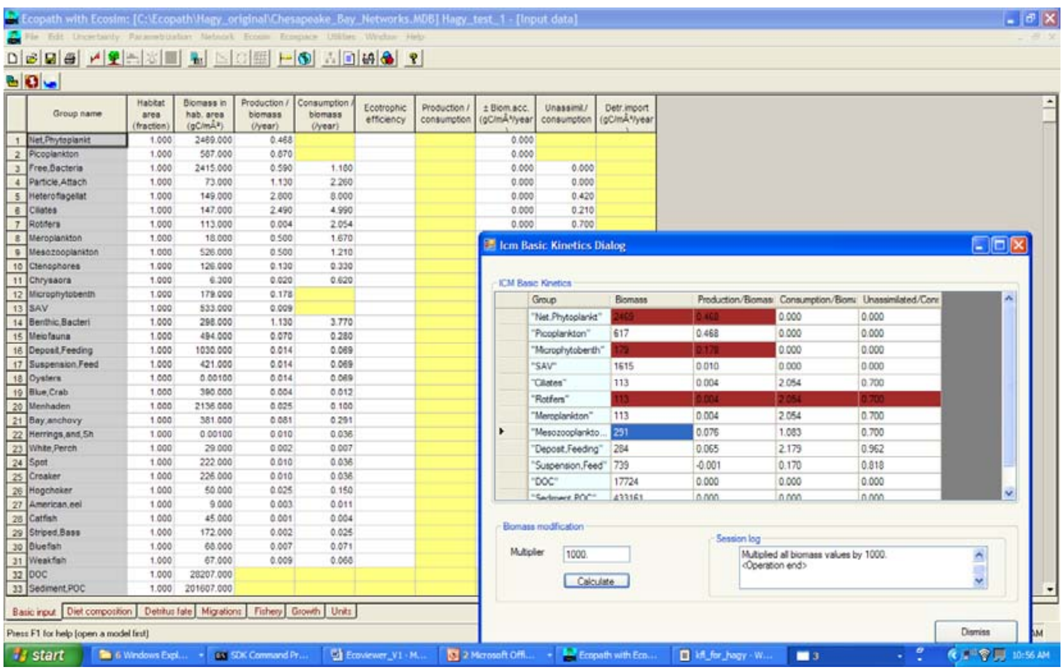
US Army Corps of Engineers®
Engineer Research and Development Center

System-Wide Water Resources Program

User's Guide to Linking the CE-QUAL-ICM and Ecopath Models

Carl F. Cerco, Dorothy H. Tillman, and Terry K. Gerald

August 2009



Approved for public release; distribution is unlimited.

User's Guide to Linking the CE-QUAL-ICM and Ecopath Models

Carl F. Cerco, Dorothy H. Tillman, and Terry K. Gerald

Environmental Laboratory
U.S. Army Engineer Research and Development Center
3909 Halls Ferry Road
Vicksburg MS 39180-6199

Final report

Prepared for U.S. Army Corps of Engineers
Washington, DC 20314-1000

Under System-Wide Water Resources Program

Abstract: The present report is one of a series that documents research relating the coupling of spatially and temporally detailed eutrophication models with ecosystem models that lack spatial and temporal resolution. Specifically, the Corps of Engineers Integrated Compartment Water Quality Model (CE-QUAL-ICM) is coupled to the Ecopath with Ecosim (EWE) fisheries model. Previous reports in this series introduced the concepts necessary for communication between the two models and detailed the linkage. The previous linkage relied on a “human interface” between the two models. That is, information from CE-QUAL-ICM was printed and entered into the EWE input screen by hand. This process has been replaced by a graphical user interface (GUI), which is documented herein.

Contents

Figures and Tables iv

Preface v

1 Introduction 1

Linkage schematic 1

Code versions 2

2 Linking the Ecopath Model of ICM 3

Background 3

Step-by-step instructions 3

Transferring basic kinetics 4

Transferring diet composition 6

Transferring detrital fate 8

Important reminder 9

3 Linking the Ecopath Model of Chesapeake Bay 10

Introduction 10

Step-by-step instructions 10

Transferring basic kinetics 11

Transferring diet composition 13

Transferring detrital fate 14

References 16

Appendix A: The .ecm File for Ecopath Model of ICM 17

Appendix B: The .ecm File for Ecopath Model of Chesapeake Bay 18

Appendix C: The KFL Postprocessor 19

Appendix D: The forEcopathGui.f90 File 42

Appendix E: Module File for 4000-Cell KFL Postprocessor 63

Report Documentation Page

Figures and Tables

Figures

Figure 1. Flow chart for exchanging information between ICM and Ecopath. 2
Figure 2. Linux shell to compile the KFL postprocessor. 4
Figure 3. Opening the .eco and .eii files in the IcmEcoViewer GUI. 4
Figure 4. Selecting "Basic Kinetics" information to be transferred from ICM to Ecopath. 5
Figure 5. Ecopath after importing "Basic Kinetics" information from the "ICM Basic Kinetics Dialog." 6
Figure 6. Selecting "Diet Composition" information to be transferred from ICM to Ecopath. 7
Figure 7. Ecopath after importing "Diet Composition" information from the "ICM Diet Composition Dialog." 7
Figure 8. Selecting "Detritus Fate" information to be transferred from ICM to Ecopath 8
Figure 9. Ecopath after importing "Detritus Fate" information from the "ICM Detritus Fate Dialog." 9
Figure 10. The "ICM Basic Kinetics Dialog" including a biomass conversion. 12
Figure 11. Ecopath model of Chesapeake Bay after importing "Basic Kinetics" information from the "ICM Basic Kinetics Dialog." 12
Figure 12. Selecting "Diet Composition" information to be transferred from ICM to the Ecopath model of Chesapeake Bay. 13
Figure 13. Ecopath model of Chesapeake Bay after importing "Diet Composition" information from the "ICM Diet Composition Dialog." 14
Figure 14. "Detritus Fate" information to be transferred from ICM to Ecopath model of Chesapeake Bay. 15
Figure 15. Ecopath model of Chesapeake Bay after importing "Detritus Fate" information from the "ICM Detritus Fate Dialog." 15

Preface

This work was conducted under funding from the System Wide Water Resources Program (SWWRP). Dr. Steven L. Ashby is Program Manager of SWWRP. The work was conducted under the direction supervision of Dr. Barry W. Bunch, Chief, Water Quality and Contaminant Modeling Branch, Environmental Laboratory (EL), U. S. Army Engineer Research and Development Center (ERDC), Vicksburg, MS.

This report was prepared by Carl F. Cerco, Dorothy H. Tillman, and Terry K. Gerald of the Water Quality and Contaminant Modeling Branch, EL, ERDC. At the time of publication of this report, Dr. Beth Fleming was Director of EL.

COL Gary E. Johnston was Commander and Executive Director of ERDC. Dr. James R. Houston was Director.

1 Introduction

The present report is one of a series that documents research relating the coupling of spatially and temporally detailed eutrophication models with ecosystem models that lack spatial and temporal resolution. Specifically, the Corps of Engineers Integrated Compartment Water Quality Model (CE-QUAL-ICM, Cerco and Meyers 2000) is coupled to the Ecopath with Ecosim (EWE) fisheries model (Christensen et al. 2000). Previous reports in this series introduced the concepts necessary for communication between the two models (Tillman et al. 2006) and detailed the linkage (Cerco and Tillman 2008). The previous linkage relied on a “human interface” between the two models. That is, information from CE-QUAL-ICM was printed and entered into the EWE input screen by hand. This process has been replaced by a graphical user interface (GUI), which is documented herein.

Linkage schematic

The linkage (Figure 1) relies on a number of computer executable, input, and output files. The **ICM Executable** is the compiled version of CE-QUAL-ICM as applied to the subject water body. **Ecopath** is the basic steady-state, spatially averaged foundation of EWE. The ICM Executable produces a KFL Output file. The **KFL Output** file is a binary file that contains the information to be passed to EWE. The KFL Output file is read by a **KFL Postprocessor**, which is assembled from several components including the main routines, routines which relate specific versions of ICM and EWE, and modules that define variables and array sizes. The **.ecm** file is an ASCII file, prepared by the user, which associates variable names between ICM and Ecopath. The **.eco file** is produced by the KFL post-processor and conveys information from ICM into the graphical user interface. The **.eii** file is an Ecopath file used for importing and exporting information. The .eco and .eii files are input to the **GUI**, which manages the exchange of information between the two models. The GUI creates a new .eii file, which contains selected information from ICM and is read back into Ecopath.

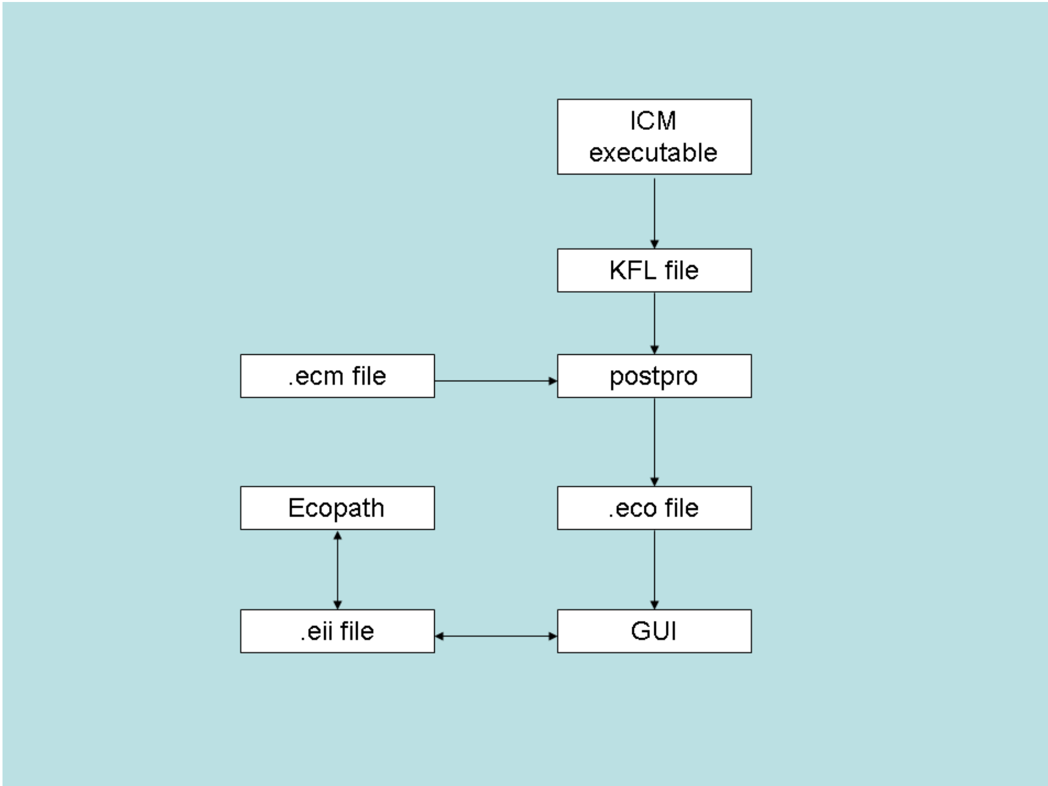


Figure 1. Flow chart for exchanging information between ICM and Ecopath.

Code versions

The version of ICM described here contains the features developed for the 2002 application to Chesapeake Bay (Cerco and Noel 2004). For development purposes, the code is applied on the 4,000-cell grid employed in the original Chesapeake Bay application (Cerco and Cole 1994). The KFL file is a binary file that must be compatible (format, array dimensions) with the KFL postprocessor, which is coded in FORTRAN 90. EWE is version 5.1 (Christensen et al. 2000), downloaded as a Windows PC executable from the Ecopath with Ecosim web site (www.ecopath.org). The Ecopath application to Chesapeake Bay was developed by Hagy (2002) and was provided by the author. The GUI is coded in C# and operates in the Windows PC environment.

2 Linking the Ecopath Model of ICM

Background

For development and debugging purposes, an Ecopath model of the ICM carbon cycle was created. This simplified Ecopath model also provides a good introduction to the GUI.

Step-by-step instructions

1. Execute the ICM model and create a KFL file.
2. Start EWE and export an .eii file based on the model of the ICM carbon cycle.
3. The names of the .ecm and .eco files are hardwired in the KFL post-processor. Edit file kfl_cfcs_4000cell.f and ensure the correct files are specified (ecm_input_file = 'fort.gui_4000V2.ecm', eco_output_file = 'fort.gui_4000V2.eco').
4. Compile the postprocessor (Figure 2).
5. The postprocessor opens file 'wqm_kfl.opt'. Link the KFL output file to wqm_kfl.opt. (ln –s wqm_kfl.sav_fix wqm_kfl.opt).
6. Execute the postprocessor (./postpro_4000). The postprocessor uses two auxiliary input files. File KFL_postpro_area.npt lists the surface cells in the ICM grid that are to be averaged into a single Ecopath domain. File sbox_col.dat lists the cells that underlie the surface cells listed in KFL_postpro_area.npt. The postprocessor creates two output files. File KFL_postpro_area_4000.opt is an ASCII listing of postprocessed information. This material was previously entered into Ecopath by hand. File fort.gui_4000V2.eco is the information input directly to the GUI.
7. Postprocessing is conducted on the same machine on which ICM is executed. If this machine is not the PC on which Ecopath is operated, the .eco file should be transferred to the PC.
8. Start the GUI by double-clicking on the IcmEcoViewer icon. Go to the "File" heading and open the ICM file (Figure 3). Go to the "File" heading again and open the EcoPath eii file.

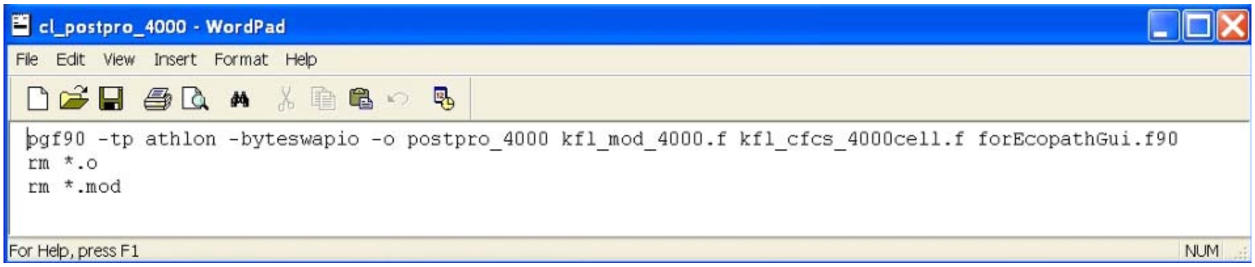


Figure 2. Linux shell to compile the KFL postprocessor.

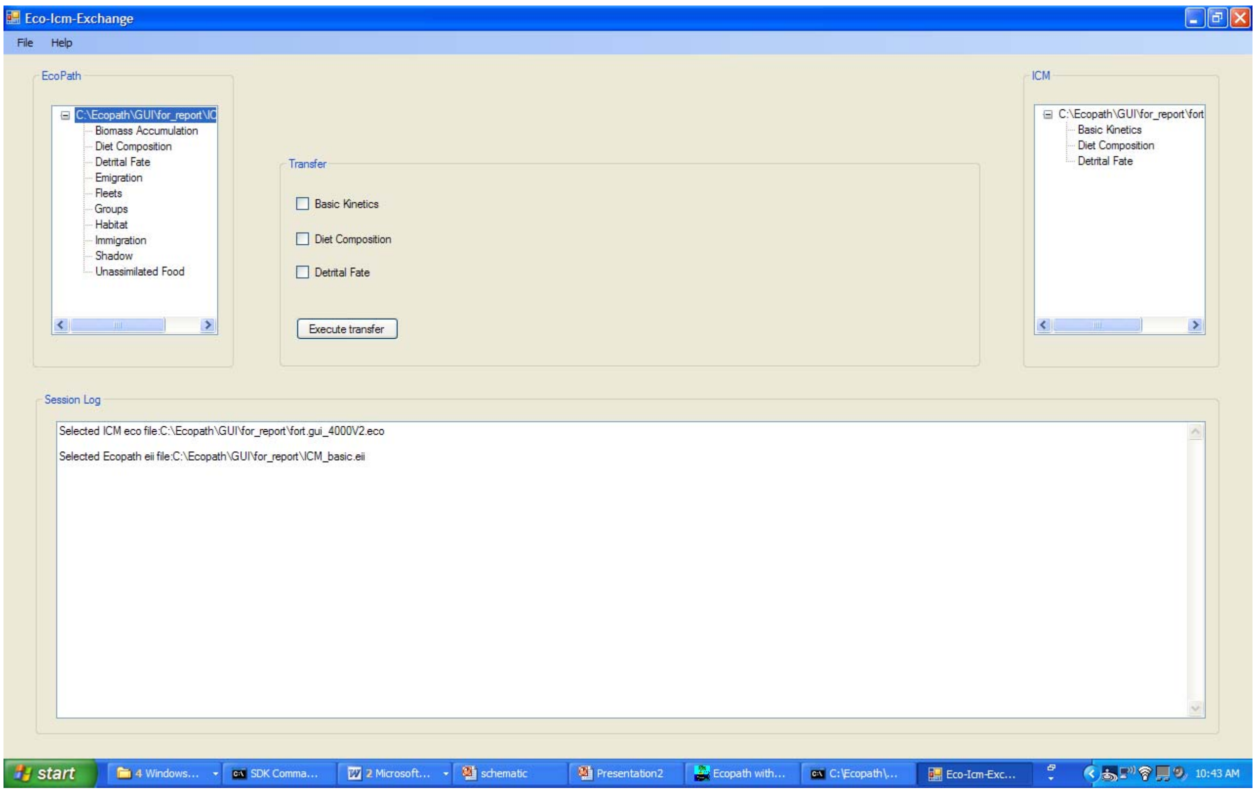


Figure 3. Opening the .eco and .eii files in the IcmEcoViewer GUI.

Transferring basic kinetics

Information may be transferred from ICM into three Ecopath screens, the Basic Kinetics screen, the Diet Composition screen, and the Detrital Fate screen. Proceed as follows to transfer information to the Ecopath Basic Kinetics screen.

1. Double-click on “Basic Kinetics” in the upper right-hand list. A screen entitled “ICM Basic Kinetics Dialog” will appear. (If not visible, look under the “Eco-Icm Exchange” window.) Double-click on the information to transfer to Ecopath. These entries will be highlighted in red (Figure 4).

2. Click in the “Basic Kinetics” box under the “Transfer” heading.
3. Click the “Execute Transfer” bar. A “Transfer Summary Report” will appear. This report can be dismissed.
4. Click the file header and then click the “Save EcoPath eii file” option. Provide a name (such as Test_1) and click the “Save” bar.
5. Activate Ecopath and click the “File” header. Click on the “Import Text (.eii)” option and navigate to the folder where the output from the GUI is stored.
6. Open the .eii file produced by the GUI. The items selected in Step 1 should appear in the Ecopath “Basic Kinetics” screen (Figure 5).

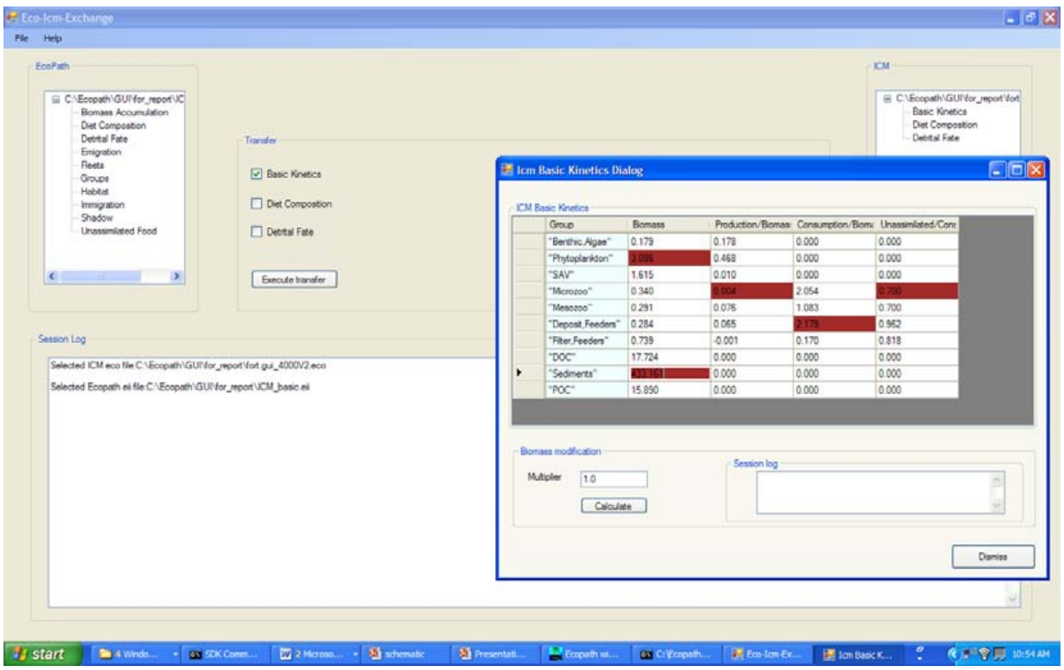


Figure 4. Selecting “Basic Kinetics” information to be transferred from ICM to Ecopath.

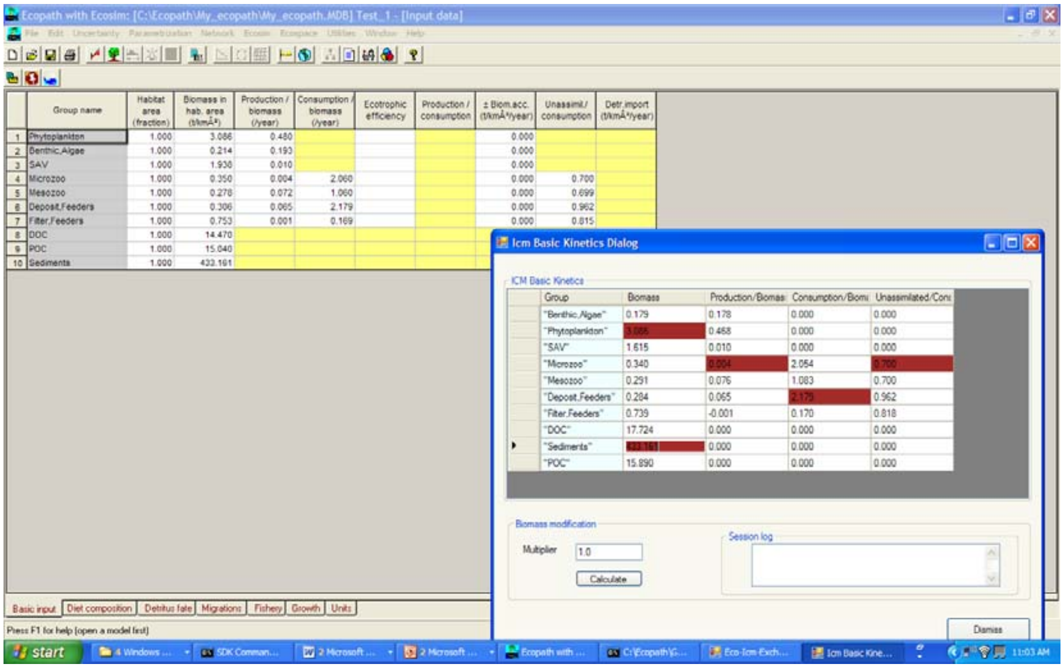


Figure 5. Ecopath after importing “Basic Kinetics” information from the “ICM Basic Kinetics Dialog.”

Transferring diet composition

1. Double-click on “Diet Composition” in the upper right-hand list. A screen entitled “ICM Diet Composition Dialog” will appear. (If not visible, look under the “Eco-Icm Exchange” window.) Double-click on the information to transfer to Ecopath. These entries will be highlighted in red (Figure 6).
2. Click in the “Diet Composition” box under the “Transfer” heading.
3. Click the “Execute Transfer” bar. A “Transfer Summary Report” will appear. This report can be dismissed.
4. Click the file header and then click the “Save EcoPath eii file” option. Provide a name (such as Test_2) and click the “Save” bar.
5. Activate Ecopath and click the “File” header. Click on the “Import Text (.eii)” option and navigate to the folder where the output from the GUI is stored.
6. Open the .eii file produced by the GUI. The items selected in Step 1 should appear in the Ecopath “Diet Composition” screen (Figure 7). (Note that the screens are transposed between the GUI and Ecopath.)

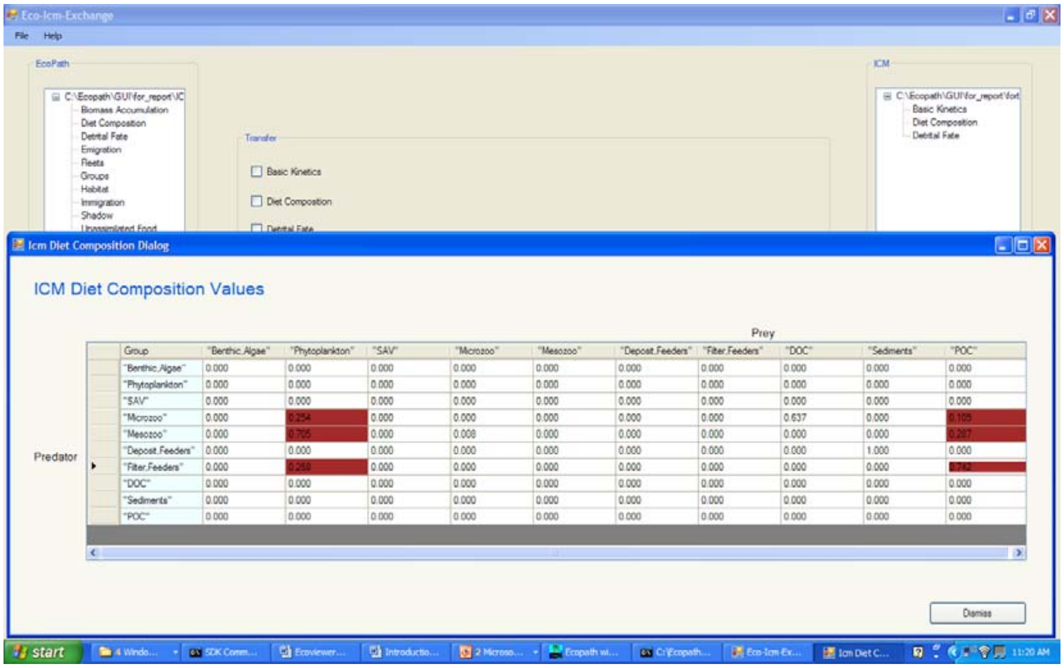


Figure 6. Selecting “Diet Composition” information to be transferred from ICM to Ecopath.

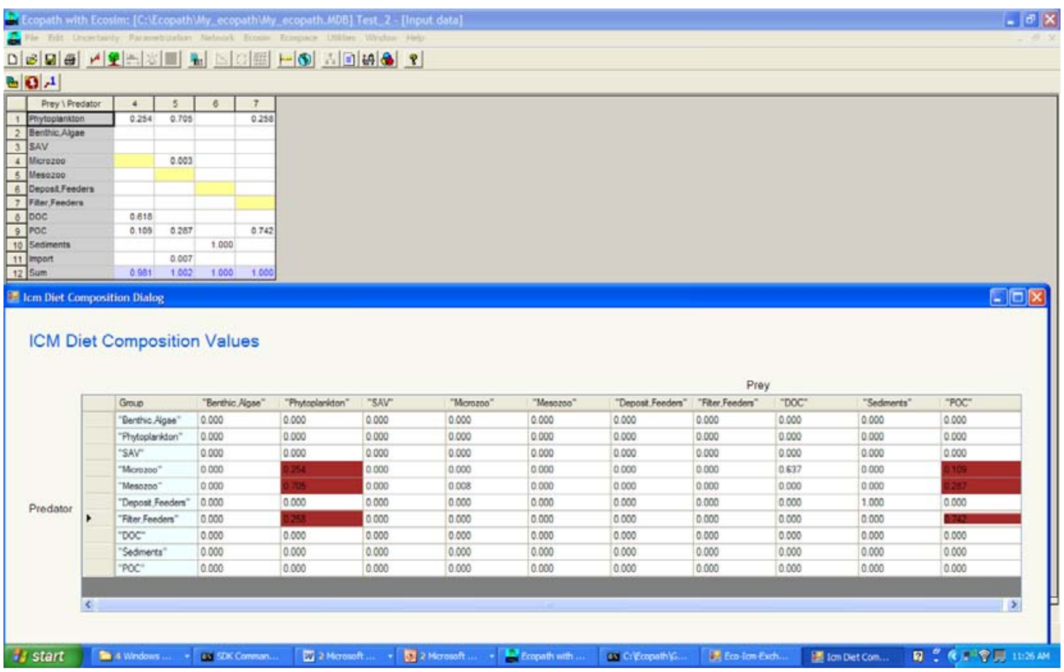


Figure 7. Ecopath after importing “Diet Composition” information from the “ICM Diet Composition Dialog.”

Transferring detrital fate

1. Double-click on “Detrital Fate” in the upper right-hand list. A screen entitled “ICM Detrital Fate Dialog” will appear. (If not visible, look under the “Eco-Icm Exchange” window.) Double-click on the information to transfer to Ecopath. These entries will be highlighted in red (Figure 8).
2. Click in the “Detrital Fate” box under the “Transfer” heading.
3. Click the “Execute Transfer” bar. A “Transfer Summary Report” will appear. This report can be dismissed.
4. Click the file header and then click the “Save EcoPath eii file” option. Provide a name (such as Test_3) and click the “Save” bar.
5. Activate Ecopath and click the “File” header. Click on the “Import Text (.eii)” option and navigate to the folder where the output from the GUI is stored.
6. Open the .eii file produced by the GUI. The items selected in Step 1 should appear in the Ecopath “Detritus Fate” screen (Figure 9). (Note that the columns are ordered differently in the GUI and Ecopath.)

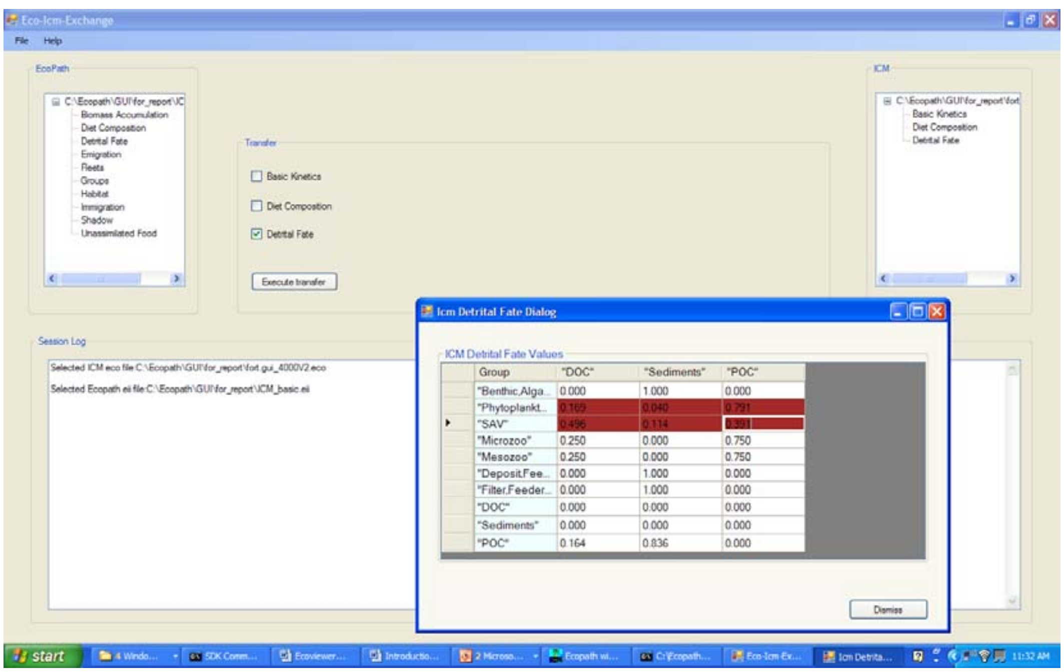


Figure 8. Selecting “Detritus Fate” information to be transferred from ICM to Ecopath.

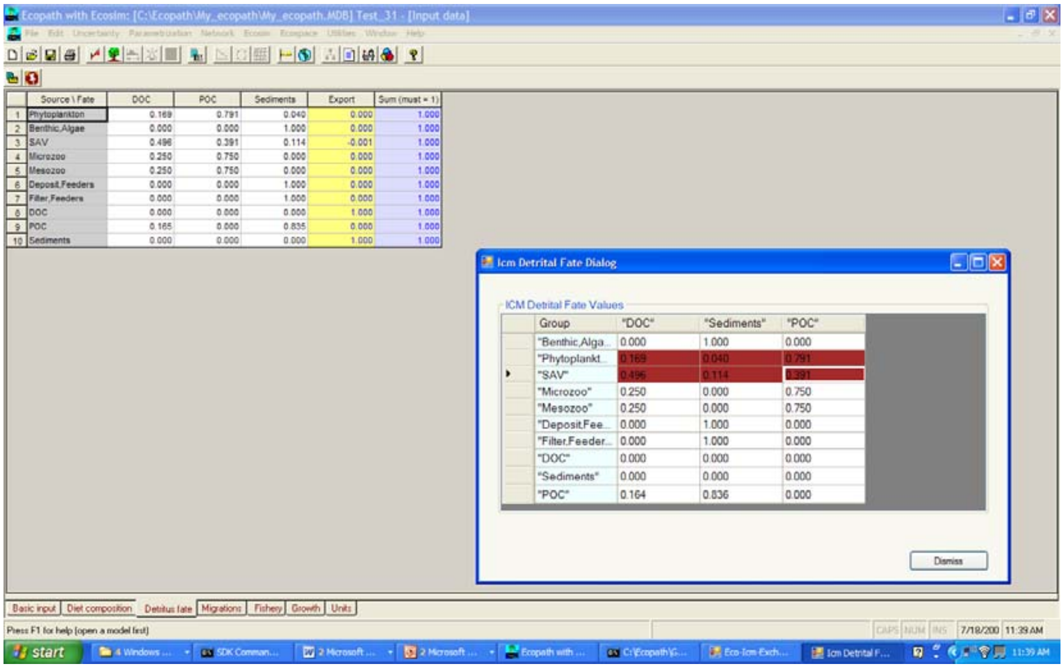


Figure 9. Ecopath after importing “Detritus Fate” information from the “ICM Detritus Fate Dialog.”

Important reminder

Application of the Ecopath model largely amounts to balancing diet composition and other parameters such that a balance is attained and all “Ecotrophic Efficiencies” remain less than unity. If the Ecopath application is balanced prior to importing information from ICM, the application will likely have to be re-balanced after new information is imported. When an .eii file is saved, an “Important Reminder” message appears which cautions the user to check mass balances when returning to Ecopath. Clicking the “OK” bar will dismiss the reminder.

3 Linking the Ecopath Model of Chesapeake Bay

Introduction

For operational purposes, ICM is linked to an Ecopath model of Chesapeake Bay (Hagy 2002). Transferring information largely follows the procedure outlined in Chapter 2 with a few exceptions necessitated by differences in state variables and units between ICM and Ecopath. ICM represents the summer phytoplankton population in Chesapeake Bay as a single group. Ecopath employs two groups: Picoplankton and Net Phytoplankton. During the transfer process the ICM phytoplankton biomass is split 80 percent Net Phytoplankton and 20 percent Picoplankton. Production-to-biomass ratios and other parameters from the single ICM group are used for both Ecopath groups. ICM employs a single microzooplankton group, while Ecopath has three: Ciliates, Rotifers, and Meroplankton. The biomass of the single ICM group is split equally into the three Ecopath groups. Production-to-biomass ratios and other parameters from the single ICM group are used for all three Ecopath groups. These splits are specified in the .ecm file (kfl_for_hagy.ecm). The ICM biomass unit is g C while Ecopath employs mg C. The units conversion is specified in the GUI as explained below.

Step-by-step instructions

1. Execute the ICM model and create a KFL file.
2. Start EWE and export an .eii file based on the model of Chesapeake Bay.
3. The names of the .ecm and .eco files are hardwired in the KFL post-processor. Edit file kfl_cfcs_4000cell.f and ensure the correct files are specified (ecm_input_file = 'hagyV2.ecm', eco_output_file = 'hagyV2.eco')
4. Compile the postprocessor (Figure 2).
5. The postprocessor opens file 'wqm_kfl.opt'. Link the KFL output file to wqm_kfl.opt. (ln –s wqm_kfl.sav_fix wqm_kfl.opt).
6. Execute the postprocessor (./postpro_4000). The postprocessor uses two auxiliary input files. File KFL_postpro_area.npt lists the surface cells in the ICM grid that are to be averaged into a single Ecopath domain. File sbox_col.dat lists the cells that underlie the surface cells

listed in KFL_postpro_area.npt. The postprocessor creates two output files. File KFL_postpro_area_4000.opt is an ASCII listing of post-processed information. This material was previously entered into Ecopath by hand. File hagyV2.eco is the information input directly to the GUI.

7. Postprocessing is conducted on the same machine on which ICM is executed. If this machine is not the PC on which Ecopath is operated, the .eco file should be transferred to the PC.
8. Start the GUI by double-clicking on the IcmEcoViewer icon. Go to the "File" heading and open the ICM file (Figure 3). Go to the "File" heading again and open the EcoPath eii file.

Transferring basic kinetics

Proceed as follows to transfer information to the Ecopath Basic Kinetics screen.

1. Double-click on "Basic Kinetics" in the upper right-hand list (Figure 4). A screen entitled "ICM Basic Kinetics Dialog" will appear. (If not visible, look under the "Eco-Icm Exchange" window.) Double-click on the information to transfer to Ecopath. These entries will be highlighted in red.
2. A box entitled "Biomass Multiplier" is situated in the lower left of the "ICM Basic Kinetics Dialog." Enter 1000 to convert g C to mg C and click the "Calculate" button (Figure 10).
3. Click in the "Basic Kinetics" box under the "Transfer" heading.
4. Click the "Execute Transfer" bar. A "Transfer Summary Report" will appear. This report can be dismissed.
5. Click the file header and then click the "Save EcoPath eii file" option. Provide a name (such as Test_1) and click the "Save" bar.
6. Activate Ecopath and click the "File" header. Click on the "Import Text (.eii)" option and navigate to the folder where the output from the GUI is stored.
7. Open the .eii file produced by the GUI. The items selected in Step 1 should appear in the Ecopath "Basic Kinetics" screen (Figure 11).

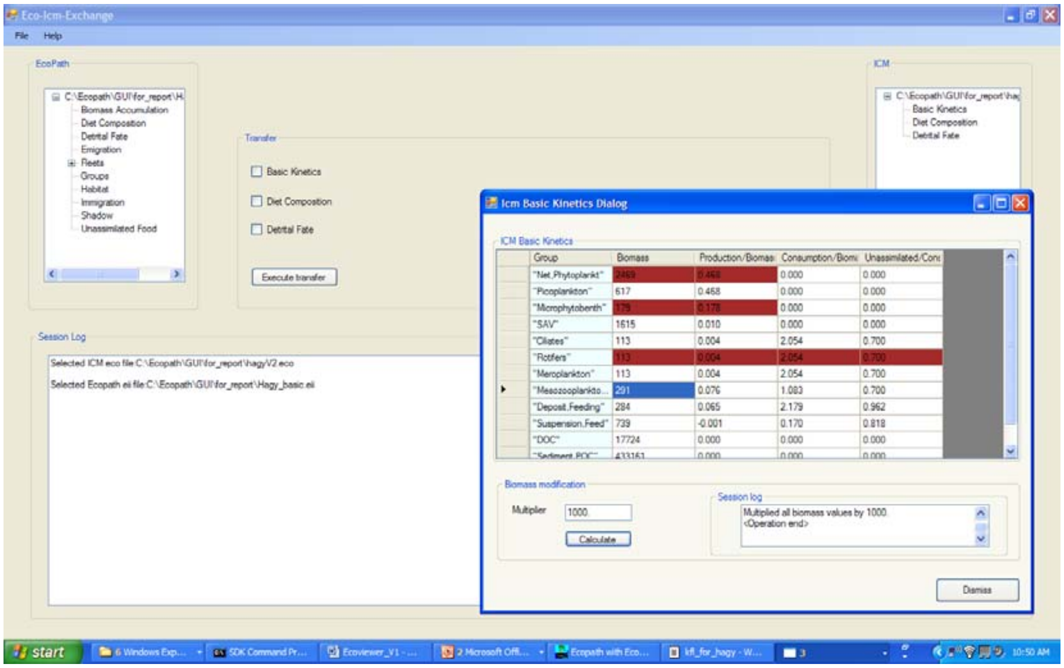


Figure 10. The “ICM Basic Kinetics Dialog” including a biomass conversion.

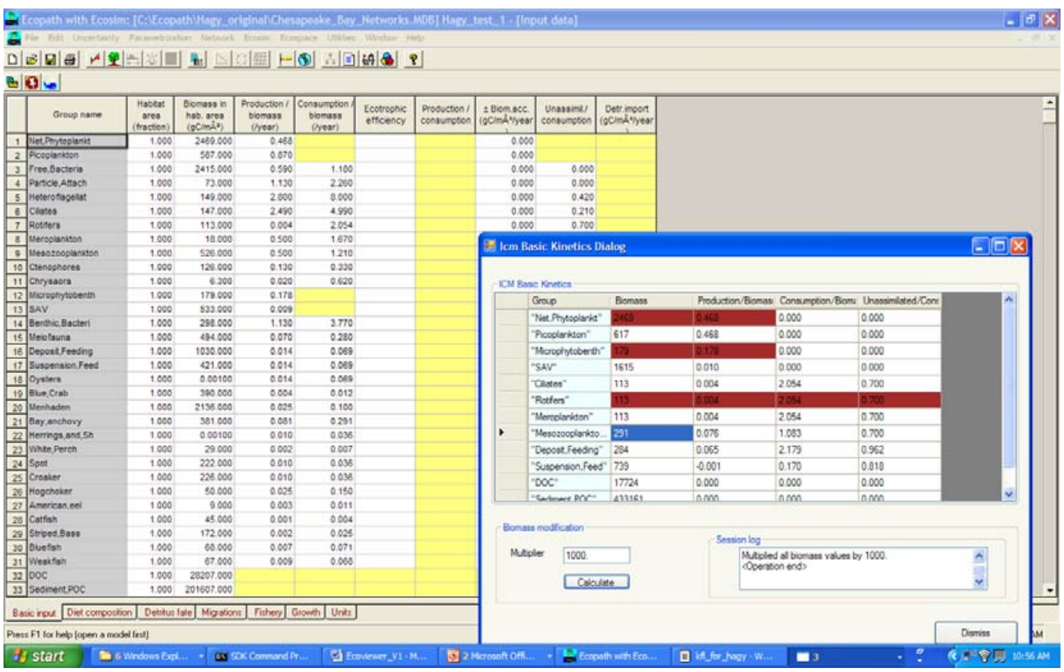


Figure 11. Ecopath model of Chesapeake Bay after importing “Basic Kinetics” information from the “ICM Basic Kinetics Dialog.”

Transferring diet composition

1. Double-click on “Diet Composition” in the upper right-hand list. A screen entitled “ICM Diet Composition Dialog” will appear. (If not visible, look under the “Eco-Icm Exchange” window.) Double-click on the information to transfer to Ecopath. These entries will be highlighted in red (Figure 12).
2. Click in the “Diet Composition” box under the “Transfer” heading.
3. Click the “Execute Transfer” bar. A “Transfer Summary Report” will appear. This report can be dismissed.
4. Click the file header and then click the “Save EcoPath eii file” option. Provide a name (such as Test_2) and click the “Save” bar.
5. Activate Ecopath and click the “File” header. Click on the “Import Text (.eii)” option and navigate to the folder where the output from the GUI is stored.
6. Open the .eii file produced by the GUI. The items selected in Step 1 should appear in the Ecopath “Diet Composition” screen (Figure 13). (Note that the screens are transposed between the GUI and Ecopath.)

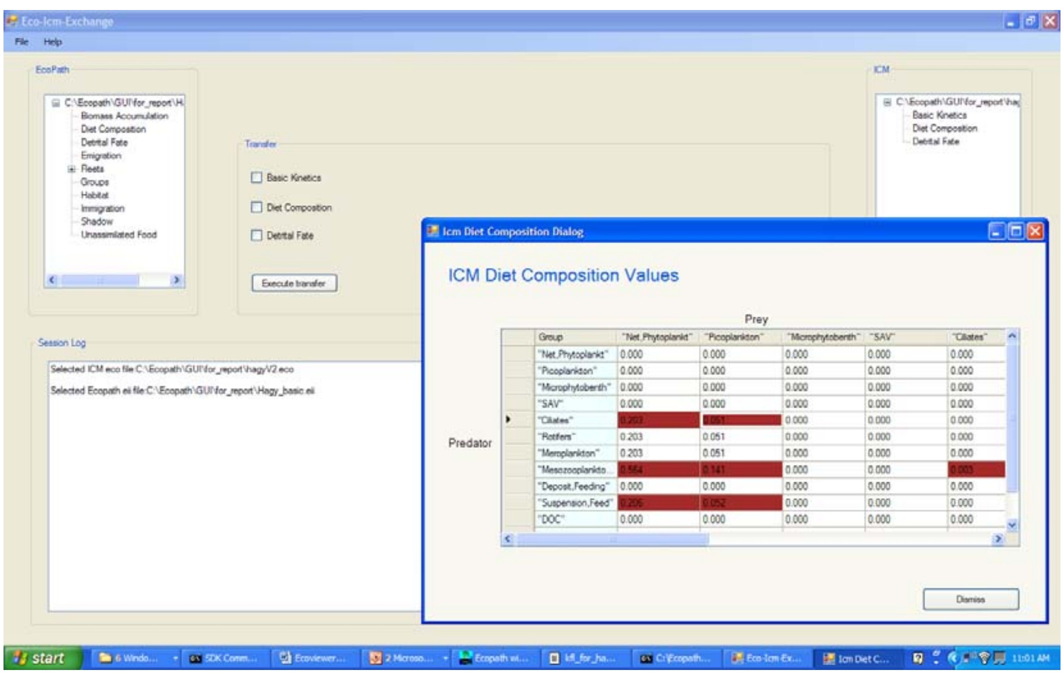


Figure 12. Selecting “Diet Composition” information to be transferred from ICM to the Ecopath model of Chesapeake Bay.

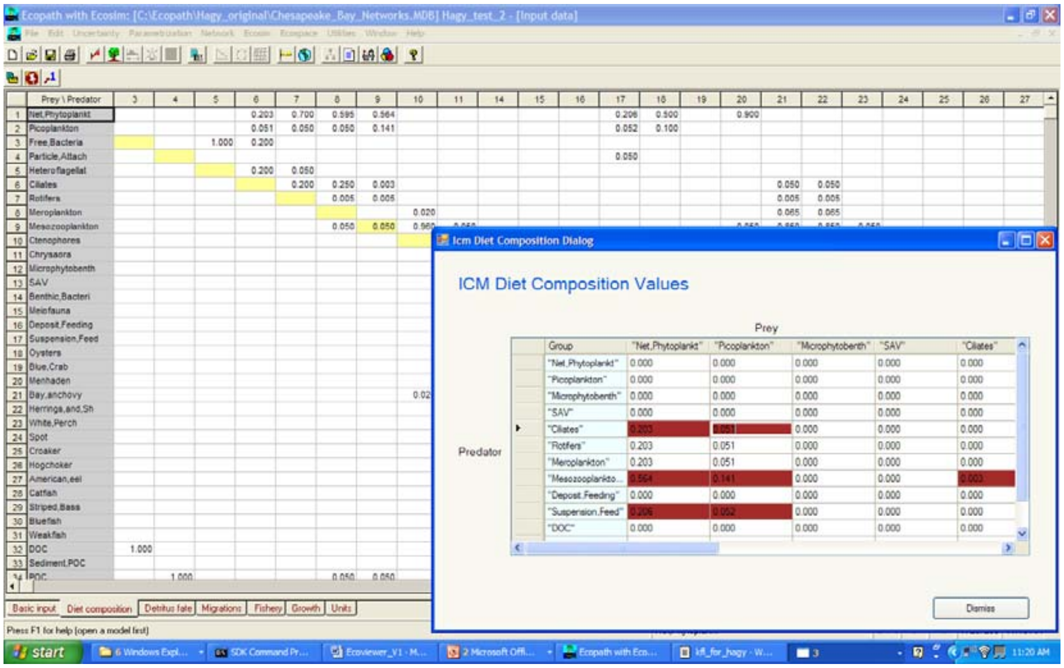


Figure 13. Ecopath model of Chesapeake Bay after importing “Diet Composition” information from the “ICM Diet Composition Dialog.”

Transferring detrital fate

1. Double-click on “Detrital Fate” in the upper right-hand list. A screen entitled “ICM Detrital Fate Dialog” will appear. (If not visible, look under the “Eco-Icm Exchange” window.) Double-click on the information to transfer to Ecopath. These entries will be highlighted in red (Figure 14).
2. Click in the “Detrital Fate” box under the “Transfer” heading.
3. Click the “Execute Transfer” bar. A “Transfer Summary Report” will appear. This report can be dismissed.
4. Click the file header and then click the “Save EcoPath eii file” option. Provide a name (such as Test_3) and click the “Save” bar.
5. Activate Ecopath and click the “File” header. Click on the “Import Text (.eii)” option and navigate to the folder where the output from the GUI is stored.
6. Open the .eii file produced by the GUI. The items selected in Step 1 should appear in the Ecopath “Detritus Fate” screen (Figure 15). (Note that the columns are ordered differently in the GUI and Ecopath.)

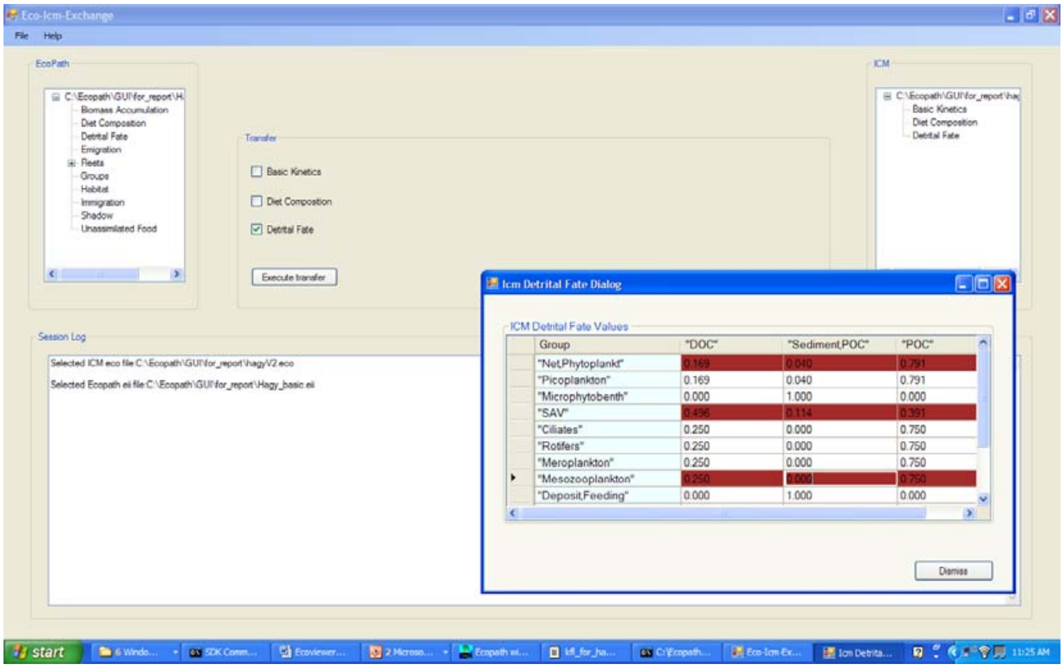


Figure 14. “Detritus Fate” information to be transferred from ICM to Ecopath model of Chesapeake Bay.

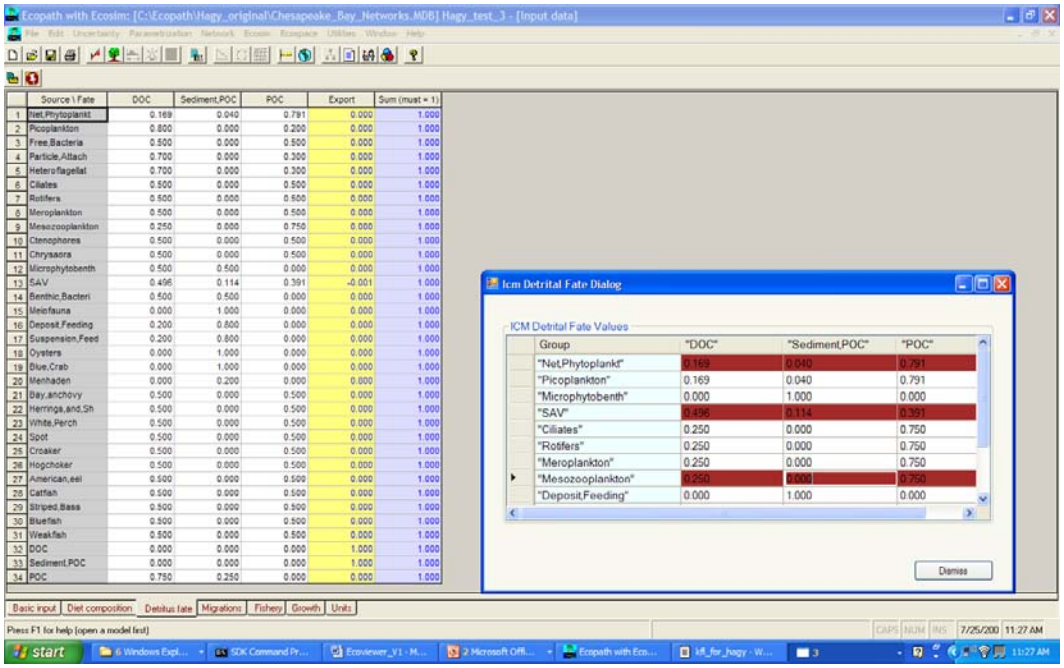


Figure 15. Ecopath model of Chesapeake Bay after importing “Detritus Fate” information from the “ICM Detritus Fate Dialog.”

References

Cerco, C., and T. Cole. 1994. *Three-dimensional eutrophication model of Chesapeake Bay*. Technical Report EL-94-4. Vicksburg, MS: U.S. Army Engineer Waterways Experiment Station.

Cerco, C., and M. Meyers. 2000. Tributary refinements to the Chesapeake Bay model. *Journal of Environmental Engineering* 126(2): 164-174.

Cerco, C., and M. Noel. 2004. *The 2002 Chesapeake Bay eutrophication model.* EPA 903-R-04-004. Annapolis, MD: Chesapeake Bay Program Office, U.S. Environmental Protection Agency.

Cerco, C., and D. Tillman. 2008. *Use of coupled eutrophication and network models for examination of fisheries and eutrophication processes*. ERDC/EL TR-08-10. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Christensen, V., C. Walters, and D. Pauly. 2000. *Ecopath with Ecosim: A user's guide*. Fisheries Centre, University of British Columbia.

Hagy, J. 2002. *Eutrophication, hypoxia and trophic transfer efficiency in Chesapeake Bay*. PhD diss., University of Maryland Center for Environmental Science, Horn Point.

Tillman, D., C. Cerco, and M. Noel. 2006. *Conceptual processes for linking eutrophication and network models*. TN-SWWRP-0905. Vicksburg MS: U.S. Army Engineer Research and Development Center.

Appendix A: The .ecm File for Ecopath Model of ICM

```
Cheaspeake Bay 4K grid, Cerco's Ecopath model of ICM

PRODUCER   COUNT    ECO_TYPE
               3           2

PRODUCER  NAMES               ICM ALIAS                     RATIO
"Benthic Algae"               "BALG"                        1.000
"Phytoplankton"               "ALG"                         1.000
"SAV"                         "SAV"                         1.000


CONSUMER   COUNT    ECO_TYPE
               4           3

CONSUMER NAMES                ICM ALIAS                     RATIO
"Microzoo"                    "Z1"                          1.000
"Mesozoo"                     "Z2"                          1.000
"Deposit Feeders"             "DF"                          1.000
"Filter Feeders"              "SF"                          1.000


DETRITUS   COUNT    ECO_TYPE
               3           4

DETRITUS NAMES                ICM ALIAS                     RATIO
"DOC"                         "DOC"                         1.000
"Sediments"                   "SEDPOC"                      1.000
"POC"                         "POC"                         1.000
```

Appendix B: The .ecm File for Ecopath Model of Chesapeake Bay

```
Cheaspeake Bay 4K grid, Hagy's model with spelling error fixed.

PRODUCER   COUNT    ECO_TYPE
               4           2

PRODUCER  NAMES               ICM ALIAS                RATIO
"Net,Phytoplankt"             "ALG"                    0.8
"Picoplankton"                "ALG"                    0.2
"Microphytobenth"             "BALG"                   1.000
"SAV"                         "SAV"                    1.000


CONSUMER   COUNT    ECO_TYPE
               6           3

CONSUMER NAMES                ICM ALIAS                RATIO
"Ciliates"                    "Z1"                     0.333
"Rotifers"                    "Z1"                     0.333
"Meroplankton"                "Z1"                     0.333
"Mesozooplankton"             "Z2"                     1.000
"Deposit,Feeding"             "DF"                     1.000
"Suspension,Feed"             "SF"                     1.000


DETRITUS   COUNT    ECO_TYPE
               3           4

DETRITUS NAMES                ICM ALIAS                RATIO
"DOC"                         "DOC"                    1.000
"Sediment POC"                "SEDPOC"                 1.000
"POC"                         "POC"                    1.000
```

Appendix C: The KFL Postprocessor

```
c A rudimentary KFL processor for checking purposes.
c Revised Feb 14, 2006 to go with new ecopath postprocessor
c Revised Jul 19, 2007 to go caluculate Diet Compositions and De-
tritus Fate
c Revised Jan 18, 2008 to include specification of ecm, eco files

***** Parameter declarations

!<TKG Moved to module>

      use kfl_mod
      use data_mod

      implicit none

      integer  i, j, k, idum, jdum, jj

      integer  ncell, nread, JREG_DAY


      real  acount
      real  REG_AREA   ! Regional area

      real  BAExport, BATotal
      real  Export

      character(len=132) :: ecm_input_file
      character(len=132) :: eco_output_file



      ! TKG: Specify the ecopath input & output files

      ! CFC's 8 component model
      ecm_input_file = 'fort.gui_4000V2.ecm'
      eco_output_file = 'fort.gui_4000V2.eco'

      ! Hagy's 13 component model
      !ecm_input_file = 'hagyV2.ecm'
      !eco_output_file = 'hagyV2.eco'



C      OPEN(21,FILE='wqm_kfl.10YR_SENS153_new_grid_SEDFIX',
C     .    STATUS='UNKNOWN',FORM='UNFORMATTED')


      OPEN(21,FILE='wqm_kfl.opt',
     .    STATUS='UNKNOWN',FORM='UNFORMATTED')
```

```
      OPEN(22,FILE='KFL_postpro_area.npt',STATUS='UNKNOWN')

      OPEN(23,FILE='KFL_postpro_area_4000.opt',STATUS='UNKNOWN')

      OPEN(24,FILE='sbox_col.dat',STATUS='OLD')

C READ FILE THAT MAPS SURFACE BOXES TO REST OF COLUMN
      DO I=1,729
c      DO I=1,3162
       READ(24,*) NBOXCOL(I),(BOX(I,J),J=1,NBOXCOL(I))
c        READ(24,*,END=50) idum, jdum, NBOXCOL(I), (BOX(I,J),
c     .        J=1,NBOXCOL(I))
c        PRINT*, idum, jdum, NBOXCOL(I), (BOX(I,J),
c     .        J=1,NBOXCOL(I))
      END DO

 50   Continue
C ZERO OUT AVERAGE REGIONAL SUMS

            AREG_JDAY=0.0
            AREG_ALGC=0.0
            AREG_ANPP=0.0
            AREG_AGPP=0.0
            AREG_APRED=0.0
            AREG_ADOC=0.0
            AREG_APOC=0.0

            AREG_DOC=0.0
            AREG_POC=0.0
            AREG_DETC=0.0
            AREG_CRESP =0.0
            AREG_POC2DOC =0.0

            AREG_MICRZ =0.0
            AREG_MICRZR =0.0
            AREG_MICRZNP =0.0
            AREG_MICRZDOC =0.0
            AREG_MICRZPOC =0.0
            AREG_MICRZPR =0.0
            AREG_MICRZALG =0.0
            AREG_TCONSZ =0.0
            AREG_UADOCSZ =0.0
            AREG_UAPOCSZ =0.0

            AREG_MESOZ =0.0
            AREG_MESOZR =0.0
            AREG_MESOZNP =0.0
            AREG_MESOZPOC =0.0
            AREG_MESOZPR =0.0
            AREG_MESOZALG =0.0
            AREG_MIC2MES =0.0
            AREG_TCONLZ =0.0
            AREG_UADOCLZ =0.0
            AREG_UAPOCLZ =0.0

            AREG_BURIAL = 0.0
            AREG_CFLUX = 0.0
```

```
          AREG_SEDR = 0.0
          AREG_ALG2SED = 0.0
          AREG_BALG = 0.0
          AREG_BALGR = 0.0
          AREG_BALGPR = 0.0
          AREG_BALGC = 0.0
          AREG_BNPP = 0.0

          AREG_SAV = 0.0
          AREG_SAVNP = 0.0
          AREG_SAVR  = 0.0
          AREG_SAV2SED = 0.0
          AREG_SAV2POC = 0.0
          AREG_SAV2DOC = 0.0

          AREG_SFEED = 0.0
          AREG_SFNP = 0.0
          AREG_SFR = 0.0
          AREG_SFTCON = 0.0
          AREG_SFACON = 0.0
          AREG_SFPCCON = 0.0
          AREG_SFUAC = 0.0
          AREG_DFEED = 0.0
          AREG_DFNP = 0.0
          AREG_DFR  = 0.0
          AREG_DFTCON = 0.0
          AREG_DFUAC = 0.0
          AREG_SEDPOC = 0.0

       ACOUNT = 0.
 1     READ (KFL) (TITLE(I),I=1,6), NB, NSB, (SBN(B),B=1,NSB),
     .  (BBN(B),B=1,NSB),
     .  (V1(B),B=0,NB),(SFA(B),B=1,NSB), SAV_CALC, BALGAE_CALC
       Write(*,*) (TITLE(I),I=1,6)

      READ(22,*,END=3) NCELL
      READ(22,*) (REG_CELL(I),I=1,NCELL)
      Write(*,*) (REG_CELL(I),I=1,NCELL)

C GET REGIONAL AREA

      REG_AREA = 0.0
      DO I=1,NCELL
        CELL = REG_CELL(I)
        REG_AREA = REG_AREA + SFA(CELL)
      END DO

C ZERO OUT REGIONAL SUMS

          DO I=1,10000
            REG_JDAY(I) =0.0
            REG_ALGC(I) =0.0
            REG_ANPP(I) =0.0
            REG_AGPP(I) =0.0
            REG_APRED(I)=0.0
            REG_ADOC(I) =0.0
            REG_APOC(I) =0.0
```

```
REG_DOC(I) =0.0
REG_POC(I) =0.0
REG_DETC(I) =0.0
REG_CRESP(I) =0.0
REG_POC2DOC(I) =0.0

REG_MICRZ(I) =0.0
REG_MICRZR(I) =0.0
REG_MICRZNP(I) =0.0
REG_MICRZDOC(I) =0.0
REG_MICRZPOC(I) =0.0
REG_MICRZPR(I) =0.0
REG_MICRZALG(I) =0.0
REG_TCONSZ(I) =0.0
REG_UADOCSZ(I) =0.0
REG_UAPOCSZ(I) =0.0

REG_MESOZ(I) =0.0
REG_MESOZR(I) =0.0
REG_MESOZNP(I) =0.0
REG_MESOZPOC(I) =0.0
REG_MESOZPR(I) =0.0
REG_MESOZALG(I) =0.0
REG_MIC2MES(I) =0.0
REG_TCONLZ(I) =0.0
REG_UADOCLZ(I) =0.0
REG_UAPOCLZ(I) =0.0

REG_BURIAL(I) = 0.0
REG_CFLUX(I) = 0.0
REG_SEDR(I)  = 0.0
REG_ALG2SED(I) = 0.0
REG_BALG(I) = 0.0
REG_BALGR(I) = 0.0
REG_BALGPR(I) = 0.0
REG_BALGC(I) = 0.0
REG_BNPP(I) = 0.0

REG_SAV(I) = 0.0
REG_SAVNP(I) = 0.0
REG_SAVR(I)  = 0.0
REG_SAV2SED(I) = 0.0
REG_SAV2POC(I) = 0.0
REG_SAV2DOC(I) = 0.0

REG_SFEED(I) = 0.0
REG_SFNP(I) = 0.0
REG_SFR(I)  = 0.0
REG_SFTCON(I) = 0.0
REG_SFACON(I) = 0.0
REG_SFPCCON(I) = 0.0
REG_SFUAC(I) = 0.0
REG_DFEED(I) = 0.0
REG_DFNP(I) = 0.0
REG_DFR(I)  = 0.0
REG_DFTCON(I) = 0.0
```

```
            REG_DFUAC(I) = 0.0
            REG_SEDPOC(I) = 0.0

        END DO

      NREAD=0
      DO I=1,10000
        READ(KFL,END=2) JDAY
        NREAD = NREAD+1
        REG_JDAY(I) = JDAY
        READ(KFL)  (E_ALGC(B),B=1,NB), (E_ANPP(B),B=1,NB),
     .               (E_AGPP(B),B=1,NB), (E_APRED(B),B=1,NB),
     .               (E_ADOC(B),B=1,NB), (E_APOC(B),B=1,NB)
        READ(KFL)  (E_DOC(B),B=1,NB),  (E_POC(B),B=1,NB),
     .               (E_DETC(B),B=1,NB), (E_CRESP(B),B=1,NB),
     .               (E_POC2DOC(B),B=1,NB)
        READ(KFL)  (E_MICRZ(B),B=1,NB),(E_MICRZR(B),B=1,NB),
     .               (E_MICRZNP(B),B=1,NB),
     .
(E_MICRZDOC(B),B=1,NB),(E_MICRZPOC(B),B=1,NB),
     .               (E_MICRZPR(B),B=1,NB),
(E_MICRZALG(B),B=1,NB),
     .               (E_TCONSZ(B),B=1,NB),
(E_UADOCSZ(B),B=1,NB),
     .               (E_UAPOCSZ(B),B=1,NB)
        READ(KFL)  (E_MESOZ(B),B=1,NB),  (E_MESOZR(B),B=1,NB),
     .
(E_MESOZNP(B),B=1,NB),(E_MESOZPOC(B),B=1,NB),
     .
(E_MESOZALG(B),B=1,NB),(E_MIC2MES(B),B=1,NB),
     .               (E_MESOZPR(B),B=1,NB),(E_TCONLZ(B),B=1,NB),
     .           (E_UADOCLZ(B),B=1,NB), (E_UAPOCLZ(B),B=1,NB)

        READ(KFL)  (E_SEDPOC(B),B=1,NSB),(E_BURIAL(B),B=1,NSB),
     .               (E_CFLUX(B),B=1,NSB),
(E_ALG2SED(B),B=1,NSB),
     .               (E_SEDR(B),B=1,NSB)
        READ(KFL)  (E_BALG(B),B=1,NSB),  (E_BNPP(B),B=1,NSB),
     .               (E_BALGR(B),B=1,NSB),
     .               (E_BALGPR(B),B=1,NSB),(E_BALGC(B),B=1,NSB)
        READ(KFL)  (E_SAV(B),B=1,NSB),   (E_SAVNP(B),B=1,NSB),
     .
(E_SAV2SED(B),B=1,NSB),(E_SAV2POC(B),B=1,NSB),
     .               (E_SAV2DOC(B),B=1,NSB),(E_SAVR(B),B=1,NSB)
        READ(KFL)  (E_SFEED(B),B=1,NSB), (E_SFNP(B),B=1,NSB),
     .               (E_SFTCON(B),B=1,NSB),(E_SFACON(B),B=1,NSB),
     .               (E_SFPCCON(B),B=1,NSB),(E_SFUAC(B),B=1,NSB),
     .               (E_SFR(B),B=1,NSB)
        READ(KFL)  (E_DFEED(B),B=1,NSB), (E_DFNP(B),B=1,NSB),
     .               (E_DFTCON(B),B=1,NSB),(E_DFUAC(B),B=1,NSB),
     .               (E_DFR(B),B=1,NSB)

C SUM THESE OVER ALL COLUMNS IN THE REGION

        DO JJ=1,NCELL

C ZERO OUT COLUMN SUMS
```

```
COL_ALGC =0.0
COL_ANPP =0.0
COL_AGPP =0.0
COL_APRED=0.0
COL_ADOC =0.0
COL_APOC =0.0

COL_DOC =0.0
COL_POC =0.0
COL_DETC =0.0
COL_CRESP =0.0
COL_POC2DOC =0.0

COL_MICRZ =0.0
COL_MICRZR =0.0
COL_MICRZNP =0.0
COL_MICRZDOC =0.0
COL_MICRZPOC =0.0
COL_MICRZPR =0.0
COL_MICRZALG =0.0
COL_TCONSZ =0.0
COL_UADOCSZ =0.0
COL_UAPOCSZ =0.0

COL_MESOZ =0.0
COL_MESOZR =0.0
COL_MESOZNP =0.0
COL_MESOZPOC =0.0
COL_MESOZPR =0.0
COL_MESOZALG =0.0
COL_MIC2MES =0.0
COL_TCONLZ =0.0
COL_UADOCLZ =0.0
COL_UAPOCLZ =0.0

CELL = REG_CELL(JJ)

DO J=1,NBOXCOL(CELL)
  K=BOX(CELL,J)
  COL_ALGC=COL_ALGC+E_ALGC(K)
  COL_ANPP=COL_ANPP+E_ANPP(K)
  COL_AGPP=COL_AGPP+E_AGPP(K)
  COL_APRED=COL_APRED+E_APRED(K)
  COL_ADOC=COL_ADOC+E_ADOC(K)
  COL_APOC=COL_APOC+E_APOC(K)

  COL_DOC=COL_DOC+E_DOC(K)
  COL_POC=COL_POC+E_POC(K)
  COL_DETC=COL_DETC+E_DETC(K)
  COL_CRESP=COL_CRESP+E_CRESP(K)
  COL_POC2DOC=COL_POC2DOC+E_POC2DOC(K)

  COL_MICRZ=COL_MICRZ+E_MICRZ(K)
  COL_MICRZR=COL_MICRZR+E_MICRZR(K)
  COL_MICRZNP=COL_MICRZNP+E_MICRZNP(K)
  COL_MICRZDOC=COL_MICRZDOC+E_MICRZDOC(K)
  COL_MICRZPOC=COL_MICRZPOC+E_MICRZPOC(K)
```

```
          COL_MICRZPR=COL_MICRZPR+E_MICRZPR(K)
          COL_MICRZALG=COL_MICRZALG+E_MICRZALG(K)
          COL_TCONSZ=COL_TCONSZ+E_TCONSZ(K)
          COL_UADOCSZ=COL_UADOCSZ+E_UADOCSZ(K)
          COL_UAPOCSZ=COL_UAPOCSZ+E_UAPOCSZ(K)

          COL_MESOZ=COL_MESOZ+E_MESOZ(K)
          COL_MESOZR=COL_MESOZR+E_MESOZR(K)
          COL_MESOZNP=COL_MESOZNP+E_MESOZNP(K)
          COL_MESOZPOC=COL_MESOZPOC+E_MESOZPOC(K)
          COL_MESOZPR=COL_MESOZPR+E_MESOZPR(K)
          COL_MESOZALG=COL_MESOZALG+E_MESOZALG(K)
          COL_MIC2MES=COL_MIC2MES+E_MIC2MES(K)
          COL_TCONLZ=COL_TCONLZ+E_TCONLZ(K)
          COL_UADOCLZ=COL_UADOCLZ+E_UADOCLZ(K)
          COL_UAPOCLZ=COL_UAPOCLZ+E_UAPOCLZ(K)
        END DO

C SAVE THE VARIABLES THAT ONLY EXIST AT THE BOTTOM

        COL_SEDPOC = E_SEDPOC(CELL)
        COL_BURIAL = E_BURIAL(CELL)
        COL_CFLUX = E_CFLUX(CELL)
        COL_ALG2SED = E_ALG2SED(CELL)
        COL_SEDR = E_SEDR(CELL)

        COL_BALG = E_BALG(CELL)
        COL_BALGR = E_BALGR(CELL)
        COL_BALGPR = E_BALGPR(CELL)
        COL_BALGC = E_BALGC(CELL)
        COL_BNPP = E_BNPP(CELL)

        COL_SAV = E_SAV(CELL)
        COL_SAVNP = E_SAVNP(CELL)
        COL_SAVR = E_SAVR(CELL)
        COL_SAV2SED = E_SAV2SED(CELL)
        COL_SAV2POC = E_SAV2POC(CELL)
        COL_SAV2DOC = E_SAV2DOC(CELL)

        COL_SFEED = E_SFEED(CELL)
        COL_SFNP = E_SFNP(CELL)
        COL_SFR = E_SFR(CELL)
        COL_SFTCON = E_SFTCON(CELL)
        COL_SFACON = E_SFACON(CELL)
        COL_SFPCCON = E_SFPCCON(CELL)
        COL_SFUAC = E_SFUAC(CELL)

        COL_DFEED = E_DFEED(CELL)
        COL_DFNP = E_DFNP(CELL)
        COL_DFR = E_DFR(CELL)
        COL_DFTCON = E_DFTCON(CELL)
        COL_DFUAC = E_DFUAC(CELL)

C SUM CELLS OVER REGION

        REG_ALGC(I)=REG_ALGC(I)+COL_ALGC*SFA(CELL)
        REG_ANPP(I)=REG_ANPP(I)+COL_ANPP*SFA(CELL)
```

```
REG_AGPP(I)=REG_AGPP(I)+COL_AGPP*SFA(CELL)
REG_APRED(I)=REG_APRED(I)+COL_APRED*SFA(CELL)
REG_ADOC(I)=REG_ADOC(I)+COL_ADOC*SFA(CELL)
REG_APOC(I)=REG_APOC(I)+COL_APOC*SFA(CELL)

REG_DOC(I)=REG_DOC(I)+COL_DOC*SFA(CELL)
REG_POC(I)=REG_POC(I)+COL_POC*SFA(CELL)
REG_DETC(I)=REG_DETC(I)+COL_DETC*SFA(CELL)
REG_CRESP(I)=REG_CRESP(I)+COL_CRESP*SFA(CELL)
REG_POC2DOC(I)=REG_POC2DOC(I)+COL_POC2DOC*SFA(CELL)

REG_MICRZ(I)=REG_MICRZ(I)+COL_MICRZ*SFA(CELL)
REG_MICRZR(I)=REG_MICRZR(I)+COL_MICRZR*SFA(CELL)
REG_MICRZNP(I)=REG_MICRZNP(I)+COL_MICRZNP*SFA(CELL)
REG_MICRZDOC(I)=REG_MICRZDOC(I)+COL_MICRZDOC*SFA(CELL)
REG_MICRZPOC(I)=REG_MICRZPOC(I)+COL_MICRZPOC*SFA(CELL)
REG_MICRZPR(I)=REG_MICRZPR(I)+COL_MICRZPR*SFA(CELL)
REG_MICRZALG(I)=REG_MICRZALG(I)+COL_MICRZALG*SFA(CELL)
REG_TCONSZ(I)=REG_TCONSZ(I)+COL_TCONSZ*SFA(CELL)
REG_UADOCSZ(I)=REG_UADOCSZ(I)+COL_UADOCSZ*SFA(CELL)
REG_UAPOCSZ(I)=REG_UAPOCSZ(I)+COL_UAPOCSZ*SFA(CELL)

REG_MESOZ(I)=REG_MESOZ(I)+COL_MESOZ*SFA(CELL)
REG_MESOZR(I)=REG_MESOZR(I)+COL_MESOZR*SFA(CELL)
REG_MESOZNP(I)=REG_MESOZNP(I)+COL_MESOZNP*SFA(CELL)
REG_MESOZPOC(I)=REG_MESOZPOC(I)+COL_MESOZPOC*SFA(CELL)
REG_MESOZPR(I)=REG_MESOZPR(I)+COL_MESOZPR*SFA(CELL)
REG_MESOZALG(I)=REG_MESOZALG(I)+COL_MESOZALG*SFA(CELL)
REG_MIC2MES(I)=REG_MIC2MES(I)+COL_MIC2MES*SFA(CELL)
REG_TCONLZ(I)=REG_TCONLZ(I)+COL_TCONLZ*SFA(CELL)
REG_UADOCLZ(I)=REG_UADOCLZ(I)+COL_UADOCLZ*SFA(CELL)
REG_UAPOCLZ(I)=REG_UAPOCLZ(I)+COL_UAPOCLZ*SFA(CELL)

REG_SEDPOC(I) = REG_SEDPOC(I)+COL_SEDPOC*SFA(CELL)
REG_SEDR(I) = REG_SEDR(I)+COL_SEDR*SFA(CELL)
REG_BURIAL(I) = REG_BURIAL(I)+COL_BURIAL*SFA(CELL)
REG_CFLUX(I) = REG_CFLUX(I)+COL_CFLUX*SFA(CELL)
REG_ALG2SED(I) = REG_ALG2SED(I)+COL_ALG2SED*SFA(CELL)

REG_BALG(I) = REG_BALG(I)+COL_BALG*SFA(CELL)
REG_BALGR(I) = REG_BALGR(I)+COL_BALGR*SFA(CELL)
REG_BALGPR(I) = REG_BALGPR(I)+COL_BALGPR*SFA(CELL)
REG_BALGC(I) = REG_BALGC(I)+COL_BALGC*SFA(CELL)
REG_BNPP(I) = REG_BNPP(I)+COL_BNPP*SFA(CELL)

REG_SAV(I) = REG_SAV(I)+COL_SAV*SFA(CELL)
REG_SAVNP(I) = REG_SAVNP(I)+COL_SAVNP*SFA(CELL)
REG_SAVR(I) = REG_SAVR(I)+COL_SAVR*SFA(CELL)
REG_SAV2SED(I) = REG_SAV2SED(I)+COL_SAV2SED*SFA(CELL)
REG_SAV2POC(I) = REG_SAV2POC(I)+COL_SAV2POC*SFA(CELL)
REG_SAV2DOC(I) = REG_SAV2DOC(I)+COL_SAV2DOC*SFA(CELL)

REG_SFEED(I) = REG_SFEED(I)+COL_SFEED*SFA(CELL)
REG_SFNP(I) = REG_SFNP(I)+COL_SFNP*SFA(CELL)
REG_SFR(I) = REG_SFR(I)+COL_SFR*SFA(CELL)
REG_SFTCON(I) = REG_SFTCON(I)+COL_SFTCON*SFA(CELL)
REG_SFACON(I) = REG_SFACON(I)+COL_SFACON*SFA(CELL)
```

```
          REG_SFPCCON(I) = REG_SFPCCON(I)+COL_SFPCCON*SFA(CELL)
          REG_SFUAC(I) = REG_SFUAC(I)+COL_SFUAC*SFA(CELL)

          REG_DFEED(I) = REG_DFEED(I)+COL_DFEED*SFA(CELL)
          REG_DFNP(I) = REG_DFNP(I)+COL_DFNP*SFA(CELL)
          REG_DFR(I) = REG_DFR(I)+COL_DFR*SFA(CELL)
          REG_DFTCON(I) = REG_DFTCON(I)+COL_DFTCON*SFA(CELL)
          REG_DFUAC(I) = REG_DFUAC(I)+COL_DFUAC*SFA(CELL)

        END DO

C DIVIDE REGIONAL SUMS BY SURFACE AREA

        REG_ALGC(I)=REG_ALGC(I)/REG_AREA
        REG_ANPP(I)=REG_ANPP(I)/REG_AREA
        REG_AGPP(I)=REG_AGPP(I)/REG_AREA
        REG_APRED(I)=REG_APRED(I)/REG_AREA
        REG_ADOC(I)=REG_ADOC(I)/REG_AREA
        REG_APOC(I)=REG_APOC(I)/REG_AREA

        REG_DOC(I)=REG_DOC(I)/REG_AREA
        REG_POC(I)=REG_POC(I)/REG_AREA
        REG_DETC(I)=REG_DETC(I)/REG_AREA
        REG_CRESP(I)=REG_CRESP(I)/REG_AREA
        REG_POC2DOC(I)=REG_POC2DOC(I)/REG_AREA

        REG_MICRZ(I)=REG_MICRZ(I)/REG_AREA
        REG_MICRZR(I)=REG_MICRZR(I)/REG_AREA
        REG_MICRZNP(I)=REG_MICRZNP(I)/REG_AREA
        REG_MICRZDOC(I)=REG_MICRZDOC(I)/REG_AREA
        REG_MICRZPOC(I)=REG_MICRZPOC(I)/REG_AREA
        REG_MICRZPR(I)=REG_MICRZPR(I)/REG_AREA
        REG_MICRZALG(I)=REG_MICRZALG(I)/REG_AREA
        REG_TCONSZ(I)=REG_TCONSZ(I)/REG_AREA
        REG_UADOCSZ(I)=REG_UADOCSZ(I)/REG_AREA
        REG_UAPOCSZ(I)=REG_UAPOCSZ(I)/REG_AREA

        REG_MESOZ(I)=REG_MESOZ(I)/REG_AREA
        REG_MESOZR(I)=REG_MESOZR(I)/REG_AREA
        REG_MESOZNP(I)=REG_MESOZNP(I)/REG_AREA
        REG_MESOZPOC(I)=REG_MESOZPOC(I)/REG_AREA
        REG_MESOZPR(I)=REG_MESOZPR(I)/REG_AREA
        REG_MESOZALG(I)=REG_MESOZALG(I)/REG_AREA
        REG_MIC2MES(I)=REG_MIC2MES(I)/REG_AREA
        REG_TCONLZ(I)=REG_TCONLZ(I)/REG_AREA
        REG_UADOCLZ(I)=REG_UADOCLZ(I)/REG_AREA
        REG_UAPOCLZ(I)=REG_UAPOCLZ(I)/REG_AREA

        REG_SEDPOC(I) = REG_SEDPOC(I)/REG_AREA
        REG_BURIAL(I) = REG_BURIAL(I)/REG_AREA
        REG_CFLUX(I) = REG_CFLUX(I)/REG_AREA
        REG_SEDR(I) = REG_SEDR(I)/REG_AREA
        REG_ALG2SED(I) = REG_ALG2SED(I)/REG_AREA

        REG_BALG(I) = REG_BALG(I)/REG_AREA
        REG_BALGR(I) = REG_BALGR(I)/REG_AREA
        REG_BALGPR(I) = REG_BALGPR(I)/REG_AREA
```

```
          REG_BALGC(I) = REG_BALGC(I)/REG_AREA
          REG_BNPP(I) = REG_BNPP(I)/REG_AREA

          REG_SAV(I) = REG_SAV(I)/REG_AREA
          REG_SAVNP(I) = REG_SAVNP(I)/REG_AREA
          REG_SAVR(I) = REG_SAVR(I)/REG_AREA
          REG_SAV2SED(I) = REG_SAV2SED(I)/REG_AREA
          REG_SAV2POC(I) = REG_SAV2POC(I)/REG_AREA
          REG_SAV2DOC(I) = REG_SAV2DOC(I)/REG_AREA

          REG_SFEED(I) = REG_SFEED(I)/REG_AREA
          REG_SFNP(I) = REG_SFNP(I)/REG_AREA
          REG_SFR(I) = REG_SFR(I)/REG_AREA
          REG_SFTCON(I) = REG_SFTCON(I)/REG_AREA
          REG_SFACON(I) = REG_SFACON(I)/REG_AREA
          REG_SFPCCON(I) = REG_SFPCCON(I)/REG_AREA
          REG_SFUAC(I) = REG_SFUAC(I)/REG_AREA

          REG_DFEED(I) = REG_DFEED(I)/REG_AREA
          REG_DFNP(I) = REG_DFNP(I)/REG_AREA
          REG_DFR(I) = REG_DFR(I)/REG_AREA
          REG_DFTCON(I) = REG_DFTCON(I)/REG_AREA
          REG_DFUAC(I) = REG_DFUAC(I)/REG_AREA
C
C Find Average Regional values over seasons
C
          JREG_DAY=REG_JDAY(I)
          WRITE(*,*)'JDAY = ',JREG_DAY
          IF(JREG_DAY .eq. 243. .or. JREG_DAY .eq. 608.
     *        .or. JREG_DAY .eq. 973.)then
              ACOUNT =ACOUNT + 1.
              WRITE(*,*)'JDAY = ',REG_JDAY(I)
              AREG_ALGC=REG_ALGC(I)+AREG_ALGC
              AREG_ANPP=REG_ANPP(I)+AREG_ANPP
              AREG_AGPP=REG_AGPP(I)+AREG_AGPP
              AREG_APRED=REG_APRED(I)+AREG_APRED
              AREG_ADOC=REG_ADOC(I)+AREG_ADOC
              AREG_APOC=REG_APOC(I)+AREG_APOC

              AREG_DOC=REG_DOC(I)+AREG_DOC
              AREG_POC=REG_POC(I)+AREG_POC
              AREG_DETC=REG_DETC(I)+AREG_DETC
              AREG_CRESP=REG_CRESP(I)+AREG_CRESP
              AREG_POC2DOC=REG_POC2DOC(I)+AREG_POC2DOC

              AREG_MICRZ=REG_MICRZ(I)+AREG_MICRZ
              AREG_MICRZR=REG_MICRZR(I)+AREG_MICRZR
              AREG_MICRZNP=REG_MICRZNP(I)+AREG_MICRZNP
              AREG_MICRZDOC=REG_MICRZDOC(I)+AREG_MICRZDOC
              AREG_MICRZPOC=REG_MICRZPOC(I)+AREG_MICRZPOC
              AREG_MICRZPR=REG_MICRZPR(I)+AREG_MICRZPR
              AREG_MICRZALG=REG_MICRZALG(I)+AREG_MICRZALG
              AREG_TCONSZ=REG_TCONSZ(I)+AREG_TCONSZ
              AREG_UADOCSZ=REG_UADOCSZ(I)+AREG_UADOCSZ
              AREG_UAPOCSZ=REG_UAPOCSZ(I)+AREG_UAPOCSZ

              AREG_MESOZ=REG_MESOZ(I)+AREG_MESOZ
```

```
            AREG_MESOZR=REG_MESOZR(I)+AREG_MESOZR
            AREG_MESOZNP=REG_MESOZNP(I)+AREG_MESOZNP
            AREG_MESOZPOC=REG_MESOZPOC(I)+AREG_MESOZPOC
            AREG_MESOZPR=REG_MESOZPR(I)+AREG_MESOZPR
            AREG_MESOZALG=REG_MESOZALG(I)+AREG_MESOZALG
            AREG_MIC2MES=REG_MIC2MES(I)+AREG_MIC2MES
            AREG_TCONLZ=REG_TCONLZ(I)+AREG_TCONLZ
            AREG_UADOCLZ=REG_UADOCLZ(I)+AREG_UADOCLZ
            AREG_UAPOCLZ=REG_UAPOCLZ(I)+AREG_UAPOCLZ

            AREG_SEDPOC = REG_SEDPOC(I)+AREG_SEDPOC
            AREG_BURIAL = REG_BURIAL(I)+AREG_BURIAL
            AREG_CFLUX = REG_CFLUX(I)+AREG_CFLUX
            AREG_SEDR = REG_SEDR(I)+AREG_SEDR
            AREG_ALG2SED = REG_ALG2SED(I)+AREG_ALG2SED

            AREG_BALG = REG_BALG(I)+AREG_BALG
            AREG_BALGR = REG_BALGR(I)+AREG_BALGR
            AREG_BALGPR = REG_BALGPR(I)+AREG_BALGPR
            AREG_BALGC = REG_BALGC(I)+AREG_BALGC
            AREG_BNPP = REG_BNPP(I)+AREG_BNPP

            AREG_SAV = REG_SAV(I)+AREG_SAV
            AREG_SAVNP = REG_SAVNP(I)+AREG_SAVNP
            AREG_SAVR = REG_SAVR(I)+AREG_SAVR
            AREG_SAV2SED = REG_SAV2SED(I)+AREG_SAV2SED
            AREG_SAV2POC = REG_SAV2POC(I)+AREG_SAV2POC
            AREG_SAV2DOC = REG_SAV2DOC(I)+AREG_SAV2DOC

            AREG_SFEED = REG_SFEED(I)+AREG_SFEED
            AREG_SFNP = REG_SFNP(I)+AREG_SFNP
            AREG_SFR = REG_SFR(I)+AREG_SFR
            AREG_SFTCON = REG_SFTCON(I)+AREG_SFTCON
            AREG_SFACON = REG_SFACON(I)+AREG_SFACON
            AREG_SFPCCON = REG_SFPCCON(I)+AREG_SFPCCON
            AREG_SFUAC = REG_SFUAC(I)+AREG_SFUAC

            AREG_DFEED = REG_DFEED(I)+AREG_DFEED
            AREG_DFNP = REG_DFNP(I)+AREG_DFNP
            AREG_DFR = REG_DFR(I)+AREG_DFR
            AREG_DFTCON = REG_DFTCON(I)+AREG_DFTCON
            AREG_DFUAC = REG_DFUAC(I)+AREG_DFUAC
         ENDIF
        Write(*,*)' I = ',I
      END DO

C WRITE THESE OUT
 2    CONTINUE


C NOW TRY TO WRITE OUT THINGS THAT ECOPATH NEEDS
 666  CONTINUE
      DO I=1,NREAD
      WRITE(23,40) REG_JDAY(I), REG_AREA
 40   FORMAT(//'    DAY ',F10.1,' AREA ',E14.6,' SQ M')

C SEDIMENTS
```

```
      WRITE(23,20)
 20   FORMAT(/' SEDIMENTS',' 	B    ','  FR ALGAE','   FR
DETR',
     $  '    FR SAV ',' DEP FEED ',' SUS FEED ','BENTH ALG ',
     $  '   BURIAL      RESP')
      WRITE(23,21) REG_SEDPOC(I),REG_ALG2SED(I),REG_CFLUX(I),
     $  REG_SAV2SED(I),
     $  REG_DFUAC(I),REG_SFUAC(I),REG_BALGC(I),REG_BURIAL(I),
     $  REG_SEDR(I)
 21   FORMAT(10X,9F10.3)

C WATER COLUMN POC
      WRITE(23,22)
 22   FORMAT(/'     POC   ','     B   ','  FROM ALG  ','FR MIZOO
',
     $  ' FR MEZOO ',' FROM SAV ',' TO MIZOO ',' TO MEZOO ',
     $'  TO SEDS ','   TO DOC  ')
      WRITE(23,23) REG_POC(I),REG_APOC(I),REG_UAPOCSZ(I),
     $
REG_UAPOCLZ(I),REG_SAV2POC(I),REG_MICRZPOC(I),REG_MESOZPOC(I),
     $  REG_CFLUX(I),REG_POC2DOC(I)
 23   FORMAT(10X,9F10.3)

C WATER COLUMN DOC
      WRITE(23,24)
 24   FORMAT(/'    DOC   ','     B    ','  FR ALGAE','  FR MIZOO
',
     $  ' FR MEZOO ','   FR SAV ',' TO MIZOO     CRESP')
      WRITE(23,25) REG_DOC(I),REG_ADOC(I),REG_UADOCSZ(I),
     $
REG_UADOCLZ(I),REG_SAV2DOC(I),REG_MICRZDOC(I),REG_CRESP(I)
 25   FORMAT(10X,7F10.3)

C PHYTOPLANKTON
      WRITE(23,26)
 26   FORMAT(/'  ALGAE   ','     B    ','       NPP  ','  TO DOC
',
     $  '  TO POC ',' TO MIZOO ',' TO MEZOO ','  TO SEDS
RESP')
      WRITE(23,27)
REG_ALGC(I),REG_ANPP(I),REG_ADOC(I),REG_APOC(I),
     $  REG_MICRZALG(I),REG_MESOZALG(I),REG_ALG2SED(I),
     $  REG_AGPP(I)-REG_ANPP(I)
 27   FORMAT(10X,8F10.3)

C MICROZOOPLANKTON
      WRITE(23,28)
 28   FORMAT(/'  MICRO Z ','     B    ','      PROD   ','   TCON
',
     $  '   UCON  ','  DOC IN  ','  POC IN ',' ALGAE IN ',
     $  '  DOC OUT  ',' POC OUT ',' TO MEZOO      RESP')
      WRITE(23,29) REG_MICRZ(I),REG_MICRZNP(I),REG_TCONSZ(I),
     $  REG_UADOCSZ(I)+REG_UAPOCSZ(I),REG_MICRZDOC(I),
     $  REG_MICRZPOC(I),REG_MICRZALG(I),REG_UADOCSZ(I),
     $  REG_UAPOCSZ(I),REG_MIC2MES(I),REG_MICRZR(I)
 29   FORMAT(10X,11F10.3)
```

```
C MESOZOOPLANKTON
      WRITE(23,30)
 30   FORMAT(/'  MESO Z ',','      B   ','       PROD   ','   TCON
',
     $  '    UCON  ','  POC IN ',' ALGAE IN ',' MICRO IN ',
     $  '  DOC OUT ','  POC OUT      RESP')
      WRITE(23,31) REG_MESOZ(I),REG_MESOZNP(I),REG_TCONLZ(I),
     $  REG_UADOCLZ(I)+REG_UAPOCLZ(I),
     $  REG_MESOZPOC(I),REG_MESOZALG(I),REG_MIC2MES(I),
     $  REG_UADOCLZ(I),REG_UAPOCLZ(I),REG_MESOZR(I)
 31   FORMAT(10X,10F10.3)

C SAV
      WRITE(23,32)
 32   FORMAT(/'    SAV   ','     B    ','       NPP  ','  TO DOC
',
     $  '   TO POC  ',' TO SEDS      RESP')
      WRITE(23,33) REG_SAV(I),REG_SAVNP(I),REG_SAV2DOC(I),
     $  REG_SAV2POC(I),REG_SAV2SED(I),REG_SAVR(I)
 33   FORMAT(10X,6F10.3)

C BENTHIC ALGAE
      WRITE(23,34)
 34   FORMAT(/'BENTHIC ALG','     B    ','      NPP  ',' TO SEDS
',
     $  '     RESP')
      WRITE(23,35)
REG_BALG(I),REG_BNPP(I),REG_BALGC(I),REG_BALGR(I)
 35   FORMAT(10X,4F10.3)

C DEPOSIT FEEDERS
      WRITE(23,36)
 36   FORMAT(/'  DEP FEED ','     B    ','     PROD   ','   TCON
',
     $  '   UCON ',' FROM SED ','   TO SED  ','    RESP')
      WRITE(23,37) REG_DFEED(I),REG_DFNP(I),REG_DFTCON(I),
     $  REG_DFUAC(I),REG_DFTCON(I),REG_DFUAC(I),REG_DFR(I)
 37   FORMAT(10X,7F10.4)

C FILTER FEEDERS
      WRITE(23,38)
 38   FORMAT(/'  SUS FEED ','     B    ','     PROD   ','   TCON
',
     $  '   UCON ',' FROM ALG ',' FROM POC ','   TO SED  ',
     $  '    RESP')
      WRITE(23,39) REG_SFEED(I),REG_SFNP(I),REG_SFTCON(I),
     $  REG_SFUAC(I),REG_SFACON(I),REG_SFPCCON(I),REG_SFUAC(I),
     $  REG_SFR(I)
 39   FORMAT(10X,8F10.3)

C
C Production/Biomass ratio
C

      PB_BALGRatio = REG_BNPP(I)/REG_BALG(I)
      PB_ALGRatio = REG_ANPP(I)/REG_ALGC(I)
      PB_Z1Ratio = REG_MICRZNP(I)/REG_MICRZ(I)
```

```
      PB_Z2Ratio = REG_MESOZNP(I)/REG_MESOZ(I)
      PB_SAVRatio = REG_SAVNP(I)/REG_SAV(I)
      PB_DFRatio = REG_DFNP(I)/REG_DFEED(I)
      PB_SFRatio = REG_SFNP(I)/REG_SFEED(I)

      WRITE(23,67)
 67   FORMAT(/'  P/B BALG  ',' P/B ALG   ',' P/B Z1   ',' P/B Z2
',
     *        'P/B SAV  ',' P/B DF    ','P/B SF    ')
      WRITE(23,68)
PB_BALGRatio,PB_ALGRatio,PB_Z1Ratio,PB_Z2Ratio,
     *             PB_SAVRatio,
     *             PB_DFRatio,PB_SFRatio
 68   FORMAT(7F10.3)

C
C Consumption/Biomass
C
      QB_Z1Ratio = REG_TCONSZ(I)/REG_MICRZ(I)
      QB_Z2Ratio = REG_TCONLZ(I)/REG_MESOZ(I)
      QB_DFRatio = REG_DFTCON(I)/REG_DFEED(I)
      QB_SFRatio = REG_SFTCON(I)/REG_SFEED(I)

      WRITE(23,71)
 71   FORMAT(/'    Q/B Z1   ',' Q/B Z2    ',
     *        'Q/B DF   ',' Q/B SF    ')
      WRITE(23,72) QB_Z1Ratio,QB_Z2Ratio,
     *             QB_DFRatio,QB_SFRatio
 72   FORMAT(7F10.3)

C
C Uassimulated/Consumption
C
      UATC_Z1Ratio =
(REG_UADOCSZ(I)+REG_UAPOCSZ(I))/REG_TCONSZ(I)
      UATC_Z2Ratio =
(REG_UADOCLZ(I)+REG_UAPOCLZ(I))/REG_TCONLZ(I)
      UATC_DFRatio = REG_DFUAC(I)/REG_DFTCON(I)
      UATC_SFRatio = REG_SFUAC(I)/REG_SFTCON(I)

      WRITE(23,73)
 73   FORMAT(/'   UA/Q Z1  ',' UA/Q Z2  ',
     *        ' UA/Q DF   ','UA/Q SF    ')
      WRITE(23,74) UATC_Z1Ratio,UATC_Z2Ratio,
     *             UATC_DFRatio,UATC_SFRatio
 74   FORMAT(7F10.3)
C
C Diet Compostion
C

C Z1 Diet Compostion
      Z1DCDOC = REG_MICRZDOC(I)/(REG_MICRZDOC(I)+REG_MICRZPOC(I)+
     *          REG_MICRZALG(I))
      Z1DCPOC = REG_MICRZPOC(I)/(REG_MICRZDOC(I)+REG_MICRZPOC(I)+
     *          REG_MICRZALG(I))
      Z1DCALG = REG_MICRZALG(I)/(REG_MICRZDOC(I)+REG_MICRZPOC(I)+
     *          REG_MICRZALG(I))
```

```
      WRITE(23,69)
 69   FORMAT(/' Z1 DC From DOC ','Z1 DC From POC ',
     *       'Z1 DC From ALG ')
      WRITE(23,70) Z1DCDOC,Z1DCPOC,Z1DCALG
 70   FORMAT(3(5X,F10.3))

C Z2 Diet Compostion
      Z2DCPOC = REG_MESOZPOC(I)/(REG_MIC2MES(I)+REG_MESOZPOC(I)+
     *          REG_MESOZALG(I))
      Z2DCZ1 = REG_MIC2MES(I)/(REG_MIC2MES(I)+REG_MESOZPOC(I)+
     *         REG_MESOZALG(I))
      Z2DCALG = REG_MESOZALG(I)/(REG_MIC2MES(I)+REG_MESOZPOC(I)+
     *          REG_MESOZALG(I))
      WRITE(23,42)
 42   FORMAT(/'  Z2 DC From POC ','  Z2 DC From Z1 ',
     *       '  Z2 DC From ALG ')
      WRITE(23,70) Z2DCPOC,Z2DCZ1,Z2DCALG
 41   FORMAT(10X,3F10.3)

C Deposit Feeders (DF) Diet Compostion
      DFDCSedPOC = REG_DFUAC(I)/REG_DFUAC(I)
      WRITE(23,43)
 43   FORMAT(/'  DF DC From SedPOC ')
      WRITE(23,70) DFDCSedPOC
 44   FORMAT(10X,3F10.3)

C Filter Feeders (SF) Diet Compostion
      SFDCPOC = REG_SFPCCON(I)/(REG_SFPCCON(I)+REG_SFACON(I))
      SFDCALG = REG_SFACON(I)/(REG_SFPCCON(I)+REG_SFACON(I))
      WRITE(23,45)
 45   FORMAT(/'  SF DC From POC ','  SF DC From ALG ')
      WRITE(23,70) SFDCPOC,SFDCALG
 46   FORMAT(10X,3F10.3)

C
C Detrital Fate
C

C Microphytobenthos Detrital Fate
      MICRBENALG_SedPOC = REG_BALGC(I)/REG_BALGC(I)
      MICRBENALG_POC = 0.
      MICRBENALG_DOC = 0.
      BAExport = 0.
      BATotal =
MICRBENALG_SedPOC+MICRBENALG_POC+MICRBENALG_DOC+Export
      WRITE(23,47)
 47   FORMAT(/'  BALG DF to DOC ',' BALG DF to SedPOC ',
     *       ' BALG DF to POC ',' BA Export','     Total Sum')
      WRITE(23,48)
MICRBENALG_DOC,MICRBENALG_SedPOC,MICRBENALG_POC,
     *             BAExport,BATotal
 48   FORMAT(f10.3,9x,f10.3,10x,f10.3,3x,f10.3,4x,f10.3)

C Phytoplankton Detrital Fate
      ALG_SedPOC = REG_ALG2SED(I)/(REG_ADOC(I)+REG_APOC(I)+
     *              REG_ALG2SED(I))
```

```
      ALG_POC =
REG_APOC(I)/(REG_ADOC(I)+REG_APOC(I)+REG_ALG2SED(I))
      ALG_DOC =
REG_ADOC(I)/(REG_ADOC(I)+REG_APOC(I)+REG_ALG2SED(I))
      AlgExport = 0.
      AlgTotal = ALG_SedPOC+ALG_POC+ALG_DOC+AlgExport
      WRITE(23,49)
 49   FORMAT(/'  ALG DF to DOC ',' ALG DF to SedPOC ',
     *       '  ALG DF to POC ',' ALG  Export',' Total Sum')
      WRITE(23,48) ALG_DOC,ALG_SedPOC,ALG_POC,
     *             AlgExport,AlgTotal

C Microzooplankton Detrital Fate
      Z1_SedPOC = 0.
      Z1_POC = REG_MICRZPOC(I)/(REG_MICRZDOC(I)+REG_MICRZPOC(I))
      Z1_DOC = REG_MICRZDOC(I)/(REG_MICRZDOC(I)+REG_MICRZPOC(I))
      Z1_POC = REG_UAPOCSZ(I)/(REG_UAPOCSZ(I)+REG_UADOCSZ(I))
      Z1_DOC = REG_UADOCSZ(I)/(REG_UAPOCSZ(I)+REG_UADOCSZ(I))
      Z1Export = 0.
      Z1Total = Z1_SedPOC +Z1_POC +Z1_DOC +Z1Export
      WRITE(23,51)
 51   FORMAT(/'  Z1 DF to DOC ','   Z1 DF to SedPOC ',
     *       '   Z1 DF to POC ','   Z1 Export  ','   Total Sum')
      WRITE(23,48) Z1_DOC,Z1_SedPOC,Z1_POC,
     *             Z1Export,Z1Total

C Mesozooplankton Detrital Fate
      Z2_SedPOC = 0.
      Z2_POC = REG_UAPOCLZ(I)/(REG_UAPOCLZ(I)+REG_UADOCLZ(I))
      Z2_DOC = REG_UADOCLZ(I)/(REG_UAPOCLZ(I)+REG_UADOCLZ(I))
      Z2Export = 0.
      Z2Total = Z2_SedPOC +Z2_POC +Z2_DOC +Z2Export
      WRITE(23,53)
 53   FORMAT(/'  Z2 DF to DOC ','   Z2 DF to SedPOC ',
     *        '   Z2 DF to POC ','   Z2 Export  ','   Total Sum')
      WRITE(23,48) Z2_DOC,Z2_SedPOC,Z2_POC,
     *             Z2Export,Z2Total

C SAV Detrital Fate
      SAV_SedPOC = REG_SAV2SED(I)/(REG_SAV2DOC(I)+REG_SAV2POC(I)+
     *             REG_SAV2SED(I))
      SAV_POC = REG_SAV2POC(I)/(REG_SAV2DOC(I)+REG_SAV2POC(I)+
     *          REG_SAV2SED(I))
      SAV_DOC = REG_SAV2DOC(I)/(REG_SAV2DOC(I)+REG_SAV2POC(I)+
     *          REG_SAV2SED(I))
      SAVExport = 0.
      SAVTotal = SAV_SedPOC +SAV_POC +SAV_DOC +SAVExport
      WRITE(23,55)
 55   FORMAT(/' SAV DF to DOC ','  SAV DF to SedPOC ',
     *       '  SAV DF to POC ','   SAV Export  ','  Total Sum')
      WRITE(23,48) SAV_DOC,SAV_SedPOC,SAV_POC,
     *             SAVExport,SAVTotal

C Deposit Feeders Detrital Fate
      DF_SedPOC = REG_DFUAC(I)/REG_DFUAC(I)
      DF_POC = 0.
      DF_DOC = 0.
```

```
      DFExport = 0.
      DFTotal = DF_SedPOC+DF_POC+DF_DOC+DFExport
      WRITE(23,57)
 57   FORMAT(/'  DF DF to DOC ',' DF DF to SedPOC ',
     *       '   DF DF to POC ','    DF Export  ','  Total Sum')
      WRITE(23,48) DF_DOC,DF_SedPOC,DF_POC,
     *             DFExport,DFTotal

C Suspension Feeders Detrital Fate
      SF_SedPOC = REG_SFUAC(I)/REG_SFUAC(I)
      SF_POC = 0.
      SF_DOC = 0.
      SFExport = 0.
      SFTotal = SF_SedPOC+SF_POC+SF_DOC+SFExport
      WRITE(23,59)
 59   FORMAT(/'  SF DF to DOC ','   SF DF to SedPOC ',
     *       '  SF DF to POC ','     SF Export  ','  Total Sum')
      WRITE(23,48) SF_DOC,SF_SedPOC,SF_POC,
     *             SFExport,SFTotal

C DOC Detrital Fate
      DOC_SedPOC = 0.
      DOC_POC = 0.
      DOC_DOC = 0.
      DOCExport = 1.
      DOCTotal = DOC_SedPOC +DOC_POC +DOC_DOC +DOCExport
      WRITE(23,61)
 61   FORMAT(/' DOC DF to DOC ','  DOC DF to SedPOC ',
     *       '  DOC DF to POC ','   DOC Export  ','  Total Sum')
      WRITE(23,48) DOC_DOC,DOC_SedPOC,DOC_POC,
     *             DOCExport,DOCTotal

C Sed POC Detrital Fate
      SedPOC_SedPOC = 0.
      SedPOC_POC = 0.
      SedPOC_DOC = 0.
      SedPOCExport = 1.
      SedPOCTotal = Sed-
POC_SedPOC+SedPOC_POC+SedPOC_DOC+SedPOCExport
      WRITE(23,63)
 63   FORMAT(/' SedPOC to DOC ','  SedPOC to SedPOC ',
     *         '  SedPOC to POC ',' SedPOC Export',' Total
Sum')
      WRITE(23,48) SedPOC_DOC,SedPOC_SedPOC,SedPOC_POC,
     *             SedPOCExport,SedPOCTotal

C POC Detrital Fate
      POC_SedPOC = REG_CFLUX(I)/(REG_CFLUX(I)+REG_POC2DOC(I))
      POC_POC = 0.
      POC_DOC = REG_POC2DOC(I)/(REG_CFLUX(I)+REG_POC2DOC(I))
      POCExport = 0.
      POCTotal = SF_SedPOC+SF_POC+SF_DOC+SFExport
      WRITE(23,65)
 65   FORMAT(/'  POC DF to DOC ','  POC DF to SedPOC ',
     *       '  POC DF to POC ','  POC Export  ','  Total Sum')
      WRITE(23,48) POC_DOC,POC_SedPOC,POC_POC,
     *             POCExport,POCTotal
```

```
      END DO
C
C Caculate Average Seasonal Values
C

       AREG_ALGC=AREG_ALGC/ACOUNT
       AREG_ANPP=AREG_ANPP/Acount
       AREG_AGPP=AREG_AGPP/ACOUNT
       AREG_APRED=AREG_APRED/ACOUNT
       AREG_ADOC=AREG_ADOC/ACOUNT
       AREG_APOC=AREG_APOC/ACOUNT

       AREG_DOC=AREG_DOC/ACOUNT
       AREG_POC=AREG_POC/ACOUNT
       AREG_DETC=AREG_DETC/ACOUNT
       AREG_CRESP=AREG_CRESP/ACOUNT
       AREG_POC2DOC=AREG_POC2DOC/ACOUNT

       AREG_MICRZ=AREG_MICRZ/ACOUNT
       AREG_MICRZR=AREG_MICRZR/ACOUNT
       AREG_MICRZNP=AREG_MICRZNP/ACOUNT
       AREG_MICRZDOC=AREG_MICRZDOC/ACOUNT
       AREG_MICRZPOC=AREG_MICRZPOC/ACOUNT
       AREG_MICRZPR=AREG_MICRZPR/ACOUNT
       AREG_MICRZALG=AREG_MICRZALG/ACOUNT
       AREG_TCONSZ=AREG_TCONSZ/ACOUNT
       AREG_UADOCSZ=AREG_UADOCSZ/ACOUNT
       AREG_UAPOCSZ=AREG_UAPOCSZ/ACOUNT

       AREG_MESOZ=AREG_MESOZ/ACOUNT
       AREG_MESOZR=AREG_MESOZR/ACOUNT
       AREG_MESOZNP=AREG_MESOZNP/ACOUNT
       AREG_MESOZPOC=AREG_MESOZPOC/ACOUNT
       AREG_MESOZPR=AREG_MESOZPR/ACOUNT
       AREG_MESOZALG=AREG_MESOZALG/ACOUNT
       AREG_MIC2MES=AREG_MIC2MES/ACOUNT
       AREG_TCONLZ=AREG_TCONLZ/ACOUNT
       AREG_UADOCLZ=AREG_UADOCLZ/ACOUNT
       AREG_UAPOCLZ=AREG_UAPOCLZ/ACOUNT

       AREG_SEDPOC = AREG_SEDPOC/ACOUNT
       AREG_BURIAL = AREG_BURIAL/ACOUNT
       AREG_CFLUX = AREG_CFLUX/ACOUNT
       AREG_SEDR = AREG_SEDR/ACOUNT
       AREG_ALG2SED = AREG_ALG2SED/ACOUNT

       AREG_BALG =AREG_BALG/ACOUNT
       AREG_BALGR =AREG_BALGR/ACOUNT
       AREG_BALGPR = AREG_BALGPR/ACOUNT
       AREG_BALGC =AREG_BALGC/ACOUNT
       AREG_BNPP = AREG_BNPP/ACOUNT

       AREG_SAV = AREG_SAV/ACOUNT
       AREG_SAVNP = AREG_SAVNP/ACOUNT
       AREG_SAVR = AREG_SAVR/ACOUNT
```

```
        AREG_SAV2SED = AREG_SAV2SED/ACOUNT
        AREG_SAV2POC = AREG_SAV2POC/ACOUNT
        AREG_SAV2DOC = AREG_SAV2DOC/ACOUNT

        AREG_SFEED = AREG_SFEED/ACOUNT
        AREG_SFNP = AREG_SFNP/ACOUNT
        AREG_SFR = AREG_SFR/ACOUNT
        AREG_SFTCON = AREG_SFTCON/ACOUNT
        AREG_SFACON = AREG_SFACON/ACOUNT
        AREG_SFPCCON = AREG_SFPCCON/ACOUNT
        AREG_SFUAC =AREG_SFUAC/ACOUNT

        AREG_DFEED =AREG_DFEED/ACOUNT
        AREG_DFNP = AREG_DFNP/ACOUNT
        AREG_DFR = AREG_DFR/ACOUNT
        AREG_DFTCON =AREG_DFTCON/ACOUNT
        AREG_DFUAC = AREG_DFUAC /ACOUNT
       WRITE(23,80)
 80    FORMAT(//'  Average Seasonal Values ')

C SEDIMENTS
      WRITE(23,20)
      WRITE(23,21) AREG_SEDPOC,AREG_ALG2SED,AREG_CFLUX,
     $  AREG_SAV2SED,
     $  AREG_DFUAC,AREG_SFUAC,AREG_BALGC,AREG_BURIAL,
     $  AREG_SEDR

C WATER COLUMN POC
      WRITE(23,22)
      WRITE(23,23) AREG_POC,AREG_APOC,AREG_UAPOCSZ,
     $  AREG_UAPOCLZ,AREG_SAV2POC,AREG_MICRZPOC,AREG_MESOZPOC,
     $  AREG_CFLUX,AREG_POC2DOC

C WATER COLUMN DOC
      WRITE(23,24)
      WRITE(23,25) AREG_DOC,AREG_ADOC,AREG_UADOCSZ,
     $  AREG_UADOCLZ,AREG_SAV2DOC,AREG_MICRZDOC,AREG_CRESP

C PHYTOPLANKTON
      WRITE(23,26)
      WRITE(23,27) AREG_ALGC,AREG_ANPP,AREG_ADOC,AREG_APOC,
     $  AREG_MICRZALG,AREG_MESOZALG,AREG_ALG2SED,
     $  AREG_AGPP-AREG_ANPP

C MICROZOOPLANKTON
      WRITE(23,28)
      WRITE(23,29) AREG_MICRZ,AREG_MICRZNP,AREG_TCONSZ,
     $  AREG_UADOCSZ+AREG_UAPOCSZ,AREG_MICRZDOC,
     $  AREG_MICRZPOC,AREG_MICRZALG,AREG_UADOCSZ,
     $  AREG_UAPOCSZ,AREG_MIC2MES,AREG_MICRZR

C MESOZOOPLANKTON
      WRITE(23,30)
      WRITE(23,31) AREG_MESOZ,AREG_MESOZNP,AREG_TCONLZ,
     $  AREG_UADOCLZ+AREG_UAPOCLZ,
     $  AREG_MESOZPOC,AREG_MESOZALG,AREG_MIC2MES,
     $  AREG_UADOCLZ,AREG_UAPOCLZ,AREG_MESOZR
```

```
C SAV
      WRITE(23,32)
      WRITE(23,33) AREG_SAV,AREG_SAVNP,AREG_SAV2DOC,
     $  AREG_SAV2POC,AREG_SAV2SED,AREG_SAVR

C BENTHIC ALGAE
      WRITE(23,34)
      WRITE(23,35) AREG_BALG,AREG_BNPP,AREG_BALGC,AREG_BALGR

C DEPOSIT FEEDERS
      WRITE(23,36)
      WRITE(23,37) AREG_DFEED,AREG_DFNP,AREG_DFTCON,
     $  AREG_DFUAC,AREG_DFTCON,AREG_DFUAC,AREG_DFR

C FILTER FEEDERS
      WRITE(23,38)
      WRITE(23,39) AREG_SFEED,AREG_SFNP,AREG_SFTCON,
     $  AREG_SFUAC,AREG_SFACON,AREG_SFPCCON,AREG_SFUAC,
     $  AREG_SFR

C
C Production/Biomass ratio
C

      APB_BALGRatio = AREG_BNPP/AREG_BALG
      APB_ALGRatio = AREG_ANPP/AREG_ALGC
      APB_Z1Ratio = AREG_MICRZNP/AREG_MICRZ
      APB_Z2Ratio = AREG_MESOZNP/AREG_MESOZ
      APB_SAVRatio = AREG_SAVNP/AREG_SAV
      APB_DFRatio = AREG_DFNP/AREG_DFEED
      APB_SFRatio = AREG_SFNP/AREG_SFEED

      WRITE(23,67)
      WRITE(23,68)
APB_BALGRatio,APB_ALGRatio,APB_Z1Ratio,APB_Z2Ratio,
     *             APB_SAVRatio,
     *             APB_DFRatio,APB_SFRatio

C
C Consumption/Biomass
C
      AQB_Z1Ratio = AREG_TCONSZ/AREG_MICRZ
      AQB_Z2Ratio = AREG_TCONLZ/AREG_MESOZ
      AQB_DFRatio = AREG_DFTCON/AREG_DFEED
      AQB_SFRatio = AREG_SFTCON/AREG_SFEED

      WRITE(23,71)
      WRITE(23,72) AQB_Z1Ratio,AQB_Z2Ratio,
     *             AQB_DFRatio,AQB_SFRatio

C
C Uassimulated/Consumption
C
      AUATC_Z1Ratio = (AREG_UADOCSZ+AREG_UAPOCSZ)/AREG_TCONSZ
      AUATC_Z2Ratio = (AREG_UADOCLZ+AREG_UAPOCLZ)/AREG_TCONLZ
      AUATC_DFRatio = AREG_DFUAC/AREG_DFTCON
```

```
      AUATC_SFRatio = AREG_SFUAC/AREG_SFTCON

      WRITE(23,73)
      WRITE(23,74) AUATC_Z1Ratio,AUATC_Z2Ratio,
     *             AUATC_DFRatio,AUATC_SFRatio
C
C Diet Compostion
C

C Z1 Diet Compostion
      AZ1DCDOC = AREG_MICRZDOC/(AREG_MICRZDOC+AREG_MICRZPOC+
     *          AREG_MICRZALG)
      AZ1DCPOC = AREG_MICRZPOC/(AREG_MICRZDOC+AREG_MICRZPOC+
     *          AREG_MICRZALG)
      AZ1DCALG = AREG_MICRZALG/(AREG_MICRZDOC+AREG_MICRZPOC+
     *          AREG_MICRZALG)
      WRITE(23,69)
      WRITE(23,70) AZ1DCDOC,AZ1DCPOC,AZ1DCALG

C Z2 Diet Compostion
      AZ2DCPOC = AREG_MESOZPOC/(AREG_MIC2MES+AREG_MESOZPOC+
     *          AREG_MESOZALG)
      AZ2DCZ1 = AREG_MIC2MES/(AREG_MIC2MES+AREG_MESOZPOC+
     *         AREG_MESOZALG)
      AZ2DCALG = AREG_MESOZALG/(AREG_MIC2MES+AREG_MESOZPOC+
     *          AREG_MESOZALG)
      WRITE(23,42)
      WRITE(23,70) AZ2DCPOC,AZ2DCZ1,AZ2DCALG

C Deposit Feeders (DF) Diet Compostion
      ADFDCSedPOC = AREG_DFUAC/AREG_DFUAC
      WRITE(23,43)
      WRITE(23,70) ADFDCSedPOC

C Filter Feeders (SF) Diet Compostion
      ASFDCPOC = AREG_SFPCCON/(AREG_SFPCCON+AREG_SFACON)
      ASFDCALG = AREG_SFACON/(AREG_SFPCCON+AREG_SFACON)
      WRITE(23,45)
      WRITE(23,70) ASFDCPOC,ASFDCALG

C
C Detrital Fate
C

C Microphytobenthos Detrital Fate
      AMICRBENALG_SedPOC = AREG_BALGC/AREG_BALGC
      AMICRBENALG_POC = 0.
      AMICRBENALG_DOC = 0.
      ABAExport = 0.
      ABATotal =
     &
AMICRBENALG_SedPOC+AMICRBENALG_POC+AMICRBENALG_DOC+AExport
      WRITE(23,47)
      WRITE(23,48)
AMICRBENALG_DOC,AMICRBENALG_SedPOC,AMICRBENALG_POC,
     *             ABAExport,ABATotal
```

```
C Phytoplankton Detrital Fate
      AALG_SedPOC = AREG_ALG2SED/(AREG_ADOC+AREG_APOC+
     *              AREG_ALG2SED)
      AALG_POC = AREG_APOC/(AREG_ADOC+AREG_APOC+AREG_ALG2SED)
      AALG_DOC = AREG_ADOC/(AREG_ADOC+AREG_APOC+AREG_ALG2SED)
      AAlgExport = 0.
      AAlgTotal = AALG_SedPOC+AALG_POC+AALG_DOC+AAlgExport
      WRITE(23,49)
      WRITE(23,48) AALG_DOC,AALG_SedPOC,AALG_POC,
     *             AAlgExport,AAlgTotal

C Microzooplankton Detrital Fate
      AZ1_SedPOC = 0.
      AZ1_POC = AREG_UAPOCSZ/(AREG_UAPOCSZ+AREG_UADOCSZ)
      AZ1_DOC = AREG_UADOCSZ/(AREG_UAPOCSZ+AREG_UADOCSZ)
      AZ1Export = 0.
      AZ1Total = AZ1_SedPOC +AZ1_POC +AZ1_DOC +AZ1Export
      WRITE(23,51)
      WRITE(23,48) AZ1_DOC,AZ1_SedPOC,AZ1_POC,
     *             AZ1Export,AZ1Total

C Mesozooplankton Detrital Fate
      AZ2_SedPOC = 0.
      AZ2_POC = AREG_UAPOCLZ/(AREG_UAPOCLZ+AREG_UADOCLZ)
      AZ2_DOC = AREG_UADOCLZ/(AREG_UAPOCLZ+AREG_UADOCLZ)
      AZ2Export = 0.
      AZ2Total = AZ2_SedPOC +AZ2_POC +AZ2_DOC +AZ2Export
      WRITE(23,53)
      WRITE(23,48) AZ2_DOC,AZ2_SedPOC,AZ2_POC,
     *             AZ2Export,AZ2Total

C SAV Detrital Fate
      ASAV_SedPOC = AREG_SAV2SED/(AREG_SAV2DOC+AREG_SAV2POC+
     *             AREG_SAV2SED)
      ASAV_POC = AREG_SAV2POC/(AREG_SAV2DOC+AREG_SAV2POC+
     *          AREG_SAV2SED)
      ASAV_DOC = AREG_SAV2DOC/(AREG_SAV2DOC+AREG_SAV2POC+
     *          AREG_SAV2SED)
      ASAVExport = 0.
      ASAVTotal = ASAV_SedPOC +ASAV_POC +ASAV_DOC +ASAVExport
      WRITE(23,55)
      WRITE(23,48) ASAV_DOC,ASAV_SedPOC,ASAV_POC,
     *             ASAVExport,ASAVTotal

C Deposit Feeders Detrital Fate
      ADF_SedPOC = AREG_DFUAC/AREG_DFUAC
      ADF_POC = 0.
      ADF_DOC = 0.
      ADFExport = 0.
      ADFTotal = ADF_SedPOC+ADF_POC+ADF_DOC+ADFExport
      WRITE(23,57)
      WRITE(23,48) ADF_DOC,ADF_SedPOC,ADF_POC,
     *             ADFExport,ADFTotal

C Suspension Feeders Detrital Fate
      ASF_SedPOC = AREG_SFUAC/AREG_SFUAC
      ASF_POC = 0.
```

```
      ASF_DOC = 0.
      ASFExport = 0.
      ASFTotal = ASF_SedPOC+ASF_POC+ASF_DOC+ASFExport
      WRITE(23,59)
      WRITE(23,48) ASF_DOC,ASF_SedPOC,ASF_POC,
     *             ASFExport,ASFTotal

C DOC Detrital Fate
      ADOC_SedPOC = 0.
      ADOC_POC = 0.
      ADOC_DOC = 0.
      ADOCExport = 1.
      ADOCTotal = ADOC_SedPOC +ADOC_POC +ADOC_DOC +ADOCExport
      WRITE(23,61)
      WRITE(23,48) ADOC_DOC,ADOC_SedPOC,ADOC_POC,
     *             ADOCExport,ADOCTotal

C Sed POC Detrital Fate
      ASedPOC_SedPOC = 0.
      ASedPOC_POC = 0.
      ASedPOC_DOC = 0.
      ASedPOCExport = 1.
      ASedPOCTotal =
     & ASedPOC_SedPOC+ASedPOC_POC+ASedPOC_DOC+ASedPOCExport
      WRITE(23,63)
      WRITE(23,48) ASedPOC_DOC,ASedPOC_SedPOC,ASedPOC_POC,
     *             ASedPOCExport,ASedPOCTotal

C POC Detrital Fate
      APOC_SedPOC = AREG_CFLUX/(AREG_CFLUX+AREG_POC2DOC)
      APOC_POC = 0.
      APOC_DOC = AREG_POC2DOC/(AREG_CFLUX+AREG_POC2DOC)
      APOCExport = 0.
      APOCTotal = ASF_SedPOC+ASF_POC+ASF_DOC+ASFExport
      WRITE(23,65)
      WRITE(23,48) APOC_DOC,APOC_SedPOC,APOC_POC,
     *             APOCExport,APOCTotal
C
C
      REWIND (KFL)
      GO TO 1

 !3    STOP
 3    continue


      ! Write out data for the ECOPATH GUI

      call write_ecopath_gui_file(ecm_input_file,
eco_output_file)

      END
```

Appendix D: The forEcopathGui.f90 File

```
! d:\xp\work\cerco\eco\from_dottie\kfl_post_processor\

! NOTE:   integer :: funit = 101     ! TEMPORARY File unit number
used by enclosed routines



      module predator_prey_module

          ! CONCEPTUAL MAP: {PREY => ROW, PREDATOR => COLUMN}

          type predator_prey_type

                integer :: size

                character(len=20), pointer :: names(:)

                real, pointer :: values(:,:)

          endtype predator_prey_type

      contains

          function predator_prey_create_table(size, names) re-
sult(predator_prey_table)

            implicit none

            integer :: size

            character(len=*) :: names(:)

            type(predator_prey_type), pointer :: preda-
tor_prey_table

            integer :: n



            allocate(predator_prey_table)

            predator_prey_table%size = size

            allocate(predator_prey_table%names(size))

            do n=1,size
              predator_prey_table%names(n) = names(n)
            enddo
```

```
            allocate(predator_prey_table%values(size, size))

            predator_prey_table%values = 0.0

          end function predator_prey_create_table




          function preda-
tor_prey_get_table_value(predator_prey_table, prey, predator) re-
sult(value)

             implicit none

             type(predator_prey_type) :: predator_prey_table
             character(len=*) :: prey, predator
             integer :: prey_index, predator_index
             real :: value


             prey_index = preda-
tor_prey_find_index(predator_prey_table, prey)

             predator_index = preda-
tor_prey_find_index(predator_prey_table, predator)

             value = predator_prey_table%values(prey_index,
predator_index)

          end function predator_prey_get_table_value




          function preda-
tor_prey_set_table_value(predator_prey_table, prey, predator,
newValue) result(oldValue)

             implicit none

             type(predator_prey_type) :: predator_prey_table
             character(len=*) :: prey, predator
             integer :: prey_index, predator_index
             real :: newValue

             real :: oldValue

             prey_index = preda-
tor_prey_find_index(predator_prey_table, prey)

             predator_index = preda-
tor_prey_find_index(predator_prey_table, predator)

             oldValue = predator_prey_table%values(prey_index,
predator_index)
```

```
             predator_prey_table%values(prey_index, preda-
tor_index) = newValue

          end function predator_prey_set_table_value



          function predator_prey_find_index(predator_prey_table,
name) result (index)

            implicit none

            type(predator_prey_type) :: predator_prey_table

            character(len=*) :: name

            integer :: index

            integer :: n

            index = -1

            do n=1,predator_prey_table%size
                if(predator_prey_table%names(n) == name) then
                    index = n
                    return
                endif
            enddo

         end function predator_prey_find_index


      end module predator_prey_module




      module icm_constituent_module

        use kfl_mod
        use data_mod
        use predator_prey_module


        type(predator_prey_type) :: icm_diet_composition

        integer :: number_of_constituents

        character(len=20), allocatable :: names(:)

     contains
```

```
        subroutine initialize_constituent_module()

            implicit none

            number_of_constituents = 10

            allocate(names(number_of_constituents))

            ! Populate ICM constituent list

            names(1) = '"ALG"'            ! Algae
            names(2) = '"Z1"'             ! MicroZooplankton
            names(3) = '"Z2"'             ! MesoZooplankton
            names(4) = '"BALG"'           ! Benthic Algae
            names(5) = '"SAV"'            ! SAV
            names(6) = '"DF"'             ! Deposit Feeders
            names(7) = '"SF"'             ! Suspension Feeders
            names(8) = '"DOC"'            ! Dissolved Organic
Carbon
            names(9) = '"SEDPOC"'         ! Sediment Particulate
Organic Carbon
            names(10) = '"POC"'           ! Dissolved Particulate
Organic Carbon

            icm_diet_composition = preda-
tor_prey_create_table(number_of_constituents, names)

        end subroutine initialize_constituent_module



        subroutine  build_icm_predator_prey_table()

            implicit none

            icm_diet_composition = preda-
tor_prey_create_table(number_of_constituents, names)

            call calculate_icm_diet_composition()

        end subroutine  build_icm_predator_prey_table



        subroutine calculate_icm_diet_composition()

            implicit none

            integer :: pred_index, prey_index

            integer :: n
```

```
            character(len=20), pointer :: name

            ! Algae consumption by Z1
            prey_index = preda-
tor_prey_find_index(icm_diet_composition, '"ALG"')
            pred_index = preda-
tor_prey_find_index(icm_diet_composition, '"Z1"')
            icm_diet_composition%values(prey_index, pred_index) =
AZ1DCALG

            ! DOC consumption by Z1
            prey_index = preda-
tor_prey_find_index(icm_diet_composition, '"DOC"')
            pred_index = preda-
tor_prey_find_index(icm_diet_composition, '"Z1"')
            icm_diet_composition%values(prey_index, pred_index) =
AZ1DCDOC

             ! POC consumption by Z1
            prey_index = preda-
tor_prey_find_index(icm_diet_composition, '"POC"')
            pred_index = preda-
tor_prey_find_index(icm_diet_composition, '"Z1"')
            icm_diet_composition%values(prey_index, pred_index) =
AZ1DCPOC



            ! Algae consumption by Z2
            prey_index = preda-
tor_prey_find_index(icm_diet_composition, '"ALG"')
            pred_index = preda-
tor_prey_find_index(icm_diet_composition, '"Z2"')
            icm_diet_composition%values(prey_index, pred_index) =
AZ2DCALG

            ! Z1 consumption by Z2
            prey_index = preda-
tor_prey_find_index(icm_diet_composition, '"Z1"')
            pred_index = preda-
tor_prey_find_index(icm_diet_composition, '"Z2"')
            icm_diet_composition%values(prey_index, pred_index) =
AZ2DCZ1

            ! POC consumption by Z2
            prey_index = preda-
tor_prey_find_index(icm_diet_composition, '"POC"')
            pred_index = preda-
tor_prey_find_index(icm_diet_composition, '"Z2"')
            icm_diet_composition%values(prey_index, pred_index) =
AZ2DCPOC



            ! SedPOC consumpton by DF
```

```
            prey_index = preda-
tor_prey_find_index(icm_diet_composition, '"SEDPOC"')
            pred_index = preda-
tor_prey_find_index(icm_diet_composition, '"DF"')
            icm_diet_composition%values(prey_index, pred_index) =
ADFDCSedPOC



            ! Algae consumption by SF ! ADDED 9-20-2007
            prey_index = preda-
tor_prey_find_index(icm_diet_composition, '"ALG"')
            pred_index = preda-
tor_prey_find_index(icm_diet_composition, '"SF"')
            icm_diet_composition%values(prey_index, pred_index) =
ASFDCALG

            ! POC consumpton by SF
            prey_index = preda-
tor_prey_find_index(icm_diet_composition, '"POC"')
            pred_index = preda-
tor_prey_find_index(icm_diet_composition, '"SF"')
            icm_diet_composition%values(prey_index, pred_index) =
ASFDCPOC

        end subroutine calculate_icm_diet_composition



      end module icm_constituent_module





      module ecopath_module

          use predator_prey_module

          type(predator_prey_type) :: ecopath_diet_composition


          ! Ideally this would ne an array, but post-processor
treats them as entities.
          type detrital_fate_type
             real :: DOC
             real :: sedimentPOC
             real :: POC
          endtype detrital_fate_type



          type ecopath_group_type

              integer :: n
```

```
            character(len=20) :: name

            character(len=20) :: icm_name_alias

            real :: fraction

            real :: biomass

            real :: production_biomass_ratio

            real :: consumption_biomass_ratio

            real :: unassimilated_consumption_ratio

            type(detrital_fate_type) :: detrital_fate

        endtype  ecopath_group_type



        type ecopath_type

            type(ecopath_group_type), pointer :: groups(:)
            integer :: number_of_groups

            type(ecopath_group_type), pointer :: pro-
ducer_groups(:)
            integer :: number_producer_groups
            integer :: producer_eco_type

            type(ecopath_group_type), pointer :: con-
sumer_groups(:)
            integer :: number_consumer_groups
            integer :: consumer_eco_type

            type(ecopath_group_type), pointer :: detri-
tal_groups(:)
            integer :: number_detrital_groups
            integer :: detrital_eco_type

        endtype ecopath_type

        type(ecopath_type) :: ecopath

        integer, parameter :: outf = 102



    contains


        subroutine initialize_ecopath_module(ecm_filename,
eco_filename)

            ! ecm_filename specifies  input file
            ! eco_filename specifies  input file
```

```
        implicit none

        character(len=*) :: ecm_filename

        character(len=*) :: eco_filename

        character(len=200) :: line

        integer, parameter :: inf = 101

        integer :: m, n

        type(ecopath_group_type), pointer :: group

        character(len=20) :: name, alias

        character(len=20), pointer :: names(:)

        real :: fraction


100     format(A80)
120     format(A20)
150     format(4x,I12,I12)
200     format(A20,10x,A20,10x,f5.3)


        ! Input file
        open(unit=inf, file=ecm_filename, form='FORMATTED',
status='OLD')

        ! Output file
        open(unit=outf, file=eco_filename,
form='FORMATTED', status='UNKNOWN')



        read(inf, 100) line;   write(outf, 100) line  !
File Title


        ! Step 1: Process all PRODUCERS

        ! Read "NUMBER OF PRODUCER GROUPS"

        read(inf, 100) line;   write(outf, 100) line  !
Blank line

        read(inf, 100) line;   write(outf, 100) line  !
PRODUCER count & type header

        read(inf, 150) ecopath%number_producer_groups, eco-
path%producer_eco_type
        write(outf, 150) ecopath%number_producer_groups,
ecopath%producer_eco_type
```

```
              allo-
cate(ecopath%producer_groups(ecopath%number_producer_groups))

              do n=1,ecopath%number_producer_groups
                  ecopath%producer_groups(n)%n = -1
                  ecopath%producer_groups(n)%name = 'UNKNOWN'
                  ecopath%producer_groups(n)%icm_name_alias =
'UNKNOWN ALIAS'
                  ecopath%producer_groups(n)%fraction = 0.0
                  ecopath%producer_groups(n)%biomass = 0.0
                  eco-
path%producer_groups(n)%production_biomass_ratio = 0.0
                  eco-
path%producer_groups(n)%consumption_biomass_ratio = 0.0
                  eco-
path%producer_groups(n)%unassimilated_consumption_ratio = 0.0
                  ecopath%producer_groups(n)%detrital_fate = de-
trital_fate_type(0.0, 0.0, 0.0)
              enddo


              read(inf, 100) line;   write(outf, 100) line    !
Blank line

              read(inf, 100) line;   write(outf, 100) line    !
"Producer names"  header


              do n=1, ecopath%number_producer_groups

                  read(inf, 200) name, alias, fraction;
write(outf, 200) name, alias, fraction

                  group => ecopath%producer_groups(n)

                  group%name = name

                  group%n = n   ! group id

                  group%icm_name_alias = alias

                  group%fraction = fraction

                  !write(*,*) name

              enddo

              read(inf, 100) line;   write(outf, 100) line     !
Blank line




              ! Step 2: Process all CONSUMERS
```

```
              ! Read "NUMBER OF CONSUMER GROUPS"

              read(inf, 100) line;   write(outf, 100) line  !
Blank line

              read(inf, 100) line;   write(outf, 100) line  !
CONSUMER count & type header

              read(inf, 150) ecopath%number_consumer_groups, eco-
path%consumer_eco_type
              write(outf, 150) ecopath%number_consumer_groups,
ecopath%consumer_eco_type

              allo-
cate(ecopath%consumer_groups(ecopath%number_consumer_groups))

              do n=1,ecopath%number_consumer_groups
                  ecopath%consumer_groups(n)%n = -1
                  ecopath%consumer_groups(n)%name = 'UNKNOWN'
                  ecopath%consumer_groups(n)%icm_name_alias =
'UNKNOWN ALIAS'
                  ecopath%consumer_groups(n)%fraction = 0.0
                  ecopath%consumer_groups(n)%biomass = 0.0
                  eco-
path%consumer_groups(n)%production_biomass_ratio = 0.0
                  eco-
path%consumer_groups(n)%consumption_biomass_ratio = 0.0
                  eco-
path%consumer_groups(n)%unassimilated_consumption_ratio = 0.0
                  ecopath%consumer_groups(n)%detrital_fate = de-
trital_fate_type(0.0, 0.0, 0.0)
              enddo


              read(inf, 100) line;   write(outf, 100) line    !
Blank line

              read(inf, 100) line;   write(outf, 100) line    !
"CONSUMER names"  header


              do n=1, ecopath%number_consumer_groups

                  read(inf, 200) name, alias, fraction;
write(outf, 200) name, alias, fraction

                  group => ecopath%consumer_groups(n)

                  group%name = name

                  group%n = n   ! group id

                  group%icm_name_alias = alias

                  group%fraction = fraction

                  !write(*,*) name
```

```
              enddo

              read(inf, 100) line;   write(outf, 100) line     !
Blank line



              ! Step 3: Process all DETRITUS

              ! Read "NUMBER OF DETRITAL GROUPS"

              read(inf, 100) line;   write(outf, 100) line  !
Blank line

              read(inf, 100) line;   write(outf, 100) line  !
DETRITUS count & type header

              read(inf, 150) ecopath%number_detrital_groups, eco-
path%detrital_eco_type
              write(outf, 150) ecopath%number_detrital_groups,
ecopath%detrital_eco_type

              allo-
cate(ecopath%detrital_groups(ecopath%number_detrital_groups))

              do n=1,ecopath%number_detrital_groups
                  ecopath%detrital_groups(n)%n = -1
                  ecopath%detrital_groups(n)%name = 'UNKNOWN'
                  ecopath%detrital_groups(n)%icm_name_alias =
'UNKNOWN ALIAS'
                  ecopath%detrital_groups(n)%fraction = 0.0
                  ecopath%detrital_groups(n)%biomass = 0.0
                  eco-
path%detrital_groups(n)%production_biomass_ratio = 0.0
                  eco-
path%detrital_groups(n)%consumption_biomass_ratio = 0.0
                  eco-
path%detrital_groups(n)%unassimilated_consumption_ratio = 0.0
                  ecopath%detrital_groups(n)%detrital_fate = de-
trital_fate_type(0.0, 0.0, 0.0)
              enddo


              read(inf, 100) line;   write(outf, 100) line    !
Blank line

              read(inf, 100) line;   write(outf, 100) line    !
"DETRITUS names"  header



              do n=1, ecopath%number_detrital_groups

                  read(inf, 200) name, alias, fraction;
write(outf, 200) name, alias, fraction
```

```
            group => ecopath%detrital_groups(n)

            group%name = name

            group%n = n   ! group id

            group%icm_name_alias = alias

            group%fraction = fraction

            !write(*,*) name

        enddo

        write(outf, 100)     ! Write blank line



        ! Step 4: Combine producers, consumers, and detri-
tus into one group

        ecopath%number_of_groups = eco-
path%number_producer_groups &
                                  + eco-
path%number_consumer_groups &
                                  + eco-
path%number_detrital_groups

        allocate(ecopath%groups(ecopath%number_of_groups))

        m = 1
        do n = 1, ecopath%number_producer_groups
            ecopath%groups(m) = ecopath%producer_groups(n)
            m = m+1
        enddo

        do n = 1, ecopath%number_consumer_groups
            ecopath%groups(m) = ecopath%consumer_groups(n)
            m = m+1
        enddo

        do n = 1, ecopath%number_detrital_groups
            ecopath%groups(m) = ecopath%detrital_groups(n)
            m = m+1
        enddo



        ! Step 5: Write out group names to screen log

        do n = 1, ecopath%number_of_groups
           write(*,*) ecopath%groups(n)%name, eco-
path%groups(n)%icm_name_alias
        enddo
```

```
              close(inf);
!close(outf);



              ! L A S T   S T E P  -  B U I L D  P R E D A T O R
P R E Y   T A B L E

              ! Build predator-prey table. (Need an array of char
variables containing group name)

              allocate(names(ecopath%number_of_groups))

              do n=1,ecopath%number_of_groups
                 names(n) = ecopath%groups(n)%name
              enddo

              ecopath_diet_composition = preda-
tor_prey_create_table(ecopath%number_of_groups, names)

              deallocate(names) ! No longer needed

          end subroutine initialize_ecopath_module





!          function get_ecopath_group_type(group_name) re-
sult(targt)
!
!              implicit none
!
!              character(len=*) :: group_name
!
!              type(ecopath_group_type), pointer :: targt
!
!              integer :: n
!
!              nullify(targt)
!
!              do n=1, ecopath%number_of_groups
!                 if(ecopath%groups(n)%name .eq. group_name) then
!                    targt => ecopath%groups(n)
!                    exit
!                 endif
```

```
!               enddo
!
!           end function get_ecopath_group_type



      end module  ecopath_module





!~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

      subroutine compute_ecopath_parameters()

          use kfl_mod
          use data_mod
          use ecopath_module

          implicit none

          character(len=20) :: name
          character(len=20) :: alias
          real :: fraction

          type(ecopath_group_type), pointer :: targt

          integer :: n


          do n=1, ecopath%number_of_groups

             name = ecopath%groups(n)%name

             alias = ecopath%groups(n)%icm_name_alias

             fraction = ecopath%groups(n)%fraction

             select case (alias)

                case('"ALG"')
                    ecopath%groups(n)%biomass =
AREG_ALGC*ecopath%groups(n)%fraction
                    ecopath%groups(n)%production_biomass_ratio =
APB_ALGRatio
                    ecopath%groups(n)%detrital_fate%DOC =
AALG_DOC
                    ecopath%groups(n)%detrital_fate%SedimentPOC =
AALG_sedPOC
                    ecopath%groups(n)%detrital_fate%POC =
AALG_POC

                case('"Z1"')
```

```
                    ecopath%groups(n)%biomass =
AREG_MICRZ*ecopath%groups(n)%fraction
                    ecopath%groups(n)%production_biomass_ratio =
APB_Z1Ratio
                    ecopath%groups(n)%consumption_biomass_ratio =
AQB_Z1Ratio
                    eco-
path%groups(n)%unassimilated_consumption_ratio = AUATC_Z1Ratio
                    ecopath%groups(n)%detrital_fate%DOC = AZ1_DOC
                    ecopath%groups(n)%detrital_fate%SedimentPOC =
AZ1_sedPOC
                    ecopath%groups(n)%detrital_fate%POC = AZ1_POC

                 case('"Z2"')
                    ecopath%groups(n)%biomass =
AREG_MESOZ*ecopath%groups(n)%fraction
                    ecopath%groups(n)%production_biomass_ratio =
APB_Z2Ratio
                    ecopath%groups(n)%consumption_biomass_ratio =
AQB_Z2Ratio
                    eco-
path%groups(n)%unassimilated_consumption_ratio = AUATC_Z2Ratio
                    ecopath%groups(n)%detrital_fate%DOC = AZ2_DOC
                    ecopath%groups(n)%detrital_fate%SedimentPOC =
AZ2_sedPOC
                    ecopath%groups(n)%detrital_fate%POC = AZ2_POC

                 case('"BALG"')
                    ecopath%groups(n)%biomass =
AREG_BALG*ecopath%groups(n)%fraction
                    ecopath%groups(n)%production_biomass_ratio =
APB_BALGRatio
                    ecopath%groups(n)%detrital_fate%DOC =
AMICRBENALG_DOC
                    ecopath%groups(n)%detrital_fate%SedimentPOC =
AMICRBENALG_sedPOC
                    ecopath%groups(n)%detrital_fate%POC =
AMICRBENALG_POC

                  case('"SAV"')
                    ecopath%groups(n)%biomass =
AREG_SAV*ecopath%groups(n)%fraction
                    ecopath%groups(n)%production_biomass_ratio =
APB_SAVRatio
                    ecopath%groups(n)%detrital_fate%DOC =
ASAV_DOC
                    ecopath%groups(n)%detrital_fate%SedimentPOC =
ASAV_sedPOC
                    ecopath%groups(n)%detrital_fate%POC =
ASAV_POC

                  case('"DF"')
                    ecopath%groups(n)%biomass =
AREG_DFEED*ecopath%groups(n)%fraction
                    ecopath%groups(n)%production_biomass_ratio =
APB_DFRatio
```

```
                    ecopath%groups(n)%consumption_biomass_ratio = 
AQB_DFRatio
                    eco-
path%groups(n)%unassimilated_consumption_ratio = AUATC_DFRatio
                    ecopath%groups(n)%detrital_fate%DOC = ADF_DOC
                    ecopath%groups(n)%detrital_fate%SedimentPOC = 
ADF_sedPOC
                    ecopath%groups(n)%detrital_fate%POC = ADF_POC

                   case('"SF"')
                    ecopath%groups(n)%biomass = 
AREG_SFEED*ecopath%groups(n)%fraction
                    ecopath%groups(n)%production_biomass_ratio = 
APB_SFRatio
                    ecopath%groups(n)%consumption_biomass_ratio = 
AQB_SFRatio
                    eco-
path%groups(n)%unassimilated_consumption_ratio = AUATC_SFRatio
                    ecopath%groups(n)%detrital_fate%DOC = ASF_DOC
                    ecopath%groups(n)%detrital_fate%SedimentPOC = 
ASF_sedPOC
                    ecopath%groups(n)%detrital_fate%POC = ASF_POC

                  case('"DOC"')
                    ecopath%groups(n)%biomass = 
AREG_DOC*ecopath%groups(n)%fraction
                    ecopath%groups(n)%detrital_fate%DOC = 
ADOC_DOC
                    ecopath%groups(n)%detrital_fate%SedimentPOC = 
ADOC_sedPOC
                    ecopath%groups(n)%detrital_fate%POC = 
ADOC_POC

                  case('"SEDPOC"')
                    ecopath%groups(n)%biomass = 
AREG_SEDPOC*ecopath%groups(n)%fraction
                    ecopath%groups(n)%detrital_fate%DOC = ASed-
POC_DOC
                    ecopath%groups(n)%detrital_fate%SedimentPOC = 
ASedPOC_sedPOC
                    ecopath%groups(n)%detrital_fate%POC = ASed-
POC_POC

                  case('"POC"')
                    ecopath%groups(n)%biomass = 
AREG_POC*ecopath%groups(n)%fraction
                    !9-21-2007:ERROR HERE: eco-
path%groups(n)%detrital_fate%DOC = POC_DOC
                    ecopath%groups(n)%detrital_fate%DOC = 
APOC_DOC
                    ecopath%groups(n)%detrital_fate%SedimentPOC = 
APOC_sedPOC
                    ecopath%groups(n)%detrital_fate%POC = 
APOC_POC

                  case default
```

```
                    write(*,*) 'Error encountered in subroutine
compute_ecopath_parameters()'
                    write(*,*) alias
                    stop
             end select

          enddo

      end subroutine compute_ecopath_parameters




      subroutine write_ecopath_basic_kinetics_parameters()

          use kfl_mod
          use data_mod
          use ecopath_module

          implicit none

          character(len=200),dimension(13) :: line

          integer :: n



          write(outf,*)
          write(outf,*) 'ECOPATH INPUT'
          write(outf,*)



         ! B A S I C   K I N E T I C S

         line(1) = "BASIC kinetics"
         write(outf,*) adjustl(trim(line(1)))


         line(1) = 'GROUP              "Biomass"       "Produc-
tion/Biomass"    "Consumption/Biomass"     "Unassimi-
lated/Consumption"'
         write(outf,120) adjustl(line(1))

         do n=1, ecopath%number_of_groups

            write(outf,130) ecopath%groups(n)%name, &
                            ecopath%groups(n)%biomass,  &
                            eco-
path%groups(n)%production_biomass_ratio,  &
                            eco-
path%groups(n)%consumption_biomass_ratio,  &
                            eco-
path%groups(n)%unassimilated_consumption_ratio
         enddo
```

```
120   format(a200)
130   format(a17,  f8.3, 15x, f8.3, 15x, f8.3, 15x, f8.3)

      end subroutine write_ecopath_basic_kinetics_parameters




      subroutine write_ecopath_detrital_fate_parameters()

          use kfl_mod
          use data_mod
          use ecopath_module

          implicit none

          character(len=200),dimension(13) :: line

          integer :: n



         ! D E T R I T A L   F A T E

          write(outf,*)

          line(1) = "DETRITAL FATE (from-->to)"
          write(outf,*) adjustl(trim(line(1)))


          line(1) = 'GROUP                "DOC"         "Sediment
POC"                 "POC"'
          write(outf,120) adjustl(line(1))

          do n=1, ecopath%number_of_groups

            write(outf,130) ecopath%groups(n)%name, &
                            ecopath%groups(n)%detrital_fate%DOC,
&
                            eco-
path%groups(n)%detrital_fate%SedimentPOC,  &
                            ecopath%groups(n)%detrital_fate%POC
          enddo


120       format(a200)
130       format(a17,  f8.3, 15x, f8.3, 15x, f8.3, 15x, f8.3)

      end subroutine write_ecopath_detrital_fate_parameters
```

```
      subroutine build_ecopath_predator_prey_table()

          use predator_prey_module
          use icm_constituent_module
          use ecopath_module

          implicit none

          type( ecopath_group_type), pointer :: prey, predator

          character(len=20) :: alias_prey_name,
alias_predator_name

          integer :: icm_prey_index, icm_predator_index

          integer :: ecopath_prey_index, ecopath_predator_index

          integer m, n

          real :: icm_value, ecopath_value



          do m=1, ecopath%number_of_groups

             prey => ecopath%groups(m)

             do n=1, ecopath%number_of_groups

                predator => ecopath%groups(n)

                icm_value = preda-
tor_prey_get_table_value(icm_diet_composition,
prey%icm_name_alias, predator%icm_name_alias)

                !Per Carl, these are ratios - dont multiply by
group fraction
                !ecopath_value = icm_value * prey%fraction *
predator%fraction
                ecopath_value = icm_value * prey%fraction

                ecopath_value = preda-
tor_prey_set_table_value(ecopath_diet_composition, prey%name,
predator%name, ecopath_value)

                ! Current value of "ecopath_value" is now the
previous old value

             enddo

          enddo


      end subroutine build_ecopath_predator_prey_table
```

```
      subroutine write_ecopath_predator_prey_table()

          use predator_prey_module
          use icm_constituent_module
          use ecopath_module

          implicit none
          character(len=132),dimension(13) :: line
          character(len=20) :: prey_name
          integer :: m, n
          integer :: table_size



         ! D I E T   C O M P O S I T I O N

          write(outf,*)

          line(1) = "DIET COMPOSITION (from-->to)"
          write(outf,*) adjustl(trim(line(1)))

          table_size = ecopath_diet_composition%size

          write(outf,150) (ad-
justr(ecopath_diet_composition%names(m)), m=1,table_size)

          do m=1,  ecopath_diet_composition%size

              prey_name = ecopath_diet_composition%names(m)

              write(outf,155) prey_name, (eco-
path_diet_composition%values(m,n), n=1,table_size)

          enddo

100       format(50(A20))
120       format(A20,50(10x,f10.4))
150       format("group               ", 15(a20))
155   FORMAT(A20,13(12X,F8.3))


      end subroutine write_ecopath_predator_prey_table


!~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
```

```
      subroutine write_ecopath_gui_file(input_filename, out-
put_filename)

      ! input_filename: the "ecm" file to read
      ! output_filename: the "eco" file to create

      use ecopath_module

      use icm_constituent_module

      implicit none

      character(len=*) :: input_filename

      character(len=*) :: output_filename


      ! I N I T I A L I Z E   I C M


      ! GET DATA FROM ICM

      call initialize_constituent_module()

      call build_icm_predator_prey_table()          ! Thats the
icm_diet_composition table



      ! I N I T I A L I Z E   E C O P A T H


      call initialize_ecopath_module(input_filename, out-
put_filename)

      call compute_ecopath_parameters()

      call build_ecopath_predator_prey_table()      ! Thats the
ecopath_diet_composition table



      ! W R I T E   O U T P U T

      call write_ecopath_basic_kinetics_parameters()

      call write_ecopath_detrital_fate_parameters()

      call write_ecopath_predator_prey_table()

      close(outf)

      end subroutine write_ecopath_gui_file
```

Appendix E: Module File for 4000-Cell KFL Postprocessor

```
      module kfl_mod

      INTEGER NCP, NBP, NQFP, NHQP, NSBP, NLP, NS1P, NS2P, NS3P,
     .        NBCP,NMP, NDP, NSAVP, NFLP, NOIP, NSSFP, NPES

      PARAMETER (NCP=24)


c Chesapeake Bay ( for 1 PE run ) 4000 cells
      PARAMETER (NBP=4073,NQFP=9874,NHQP=6530,NSBP=729,NLP=15,
!CHESAPEAKE
     .           NS1P=600,NS2P=600,
!CHESAPEAKE
     .           NS3P=2961,NBCP=120,NMP=30,NDP=500,NSAVP=5,
!CHESAPEAKE
     .           NFLP=100,NOIP=10,NSSFP=3,NPES=1)
!CHESAPEAKE

c    ! Chesapeake Bay ( for 1 PE run ) 12000 cells
c      PARAMETER
(NBP=12920,NQFP=30835,NHQP=20876,NSBP=2961,NLP=19,  !CHESAPEAKE
c     .           NS1P=4000,NS2P=4000,
!CHESAPEAKE
c     .           NS3P=4000,NBCP=496,NMP=30,NDP=500,NSAVP=5,
!CHESAPEAKE
c     .           NFLP=100,NOIP=10,NSSFP=3,NPES=1)
!CHESAPEAKE

      REAL E_BALG(NSBP),  E_BNPP(NSBP),  E_DFEED(NSBP),
E_SAV(NSBP),
     .     E_CFLUX(NSBP), E_SAVNP(NSBP), E_BALGR(NSBP),
     .     E_BALGPR(NSBP),E_BALGC(NSBP), E_SFEED(NSBP),
E_BURIAL(NSBP),
     .     E_SAV2SED(NSBP),E_SAV2POC(NSBP),E_SAV2DOC(NSBP),
     .     E_DFNP(NSBP),  E_DFTCON(NSBP),E_DFUAC(NSBP),
E_SFNP(NSBP),
     .
E_SFTCON(NSBP),E_SFACON(NSBP),E_SFPCCON(NSBP),E_SFUAC(NSBP),
     .     E_ALG2SED(NSBP),E_SEDPOC(NSBP),E_SEDR(NSBP),
E_DFR(NSBP),
     .     E_SFR(NSBP),   E_SAVR(NSBP)

      REAL E_ALGC(NBP),   E_ANPP(NBP),   E_AGPP(NBP),
E_MICRZ(NBP),
     .     E_MESOZ(NBP),  E_DOC(NBP),    E_POC(NBP),
E_DETC(NBP),
     .     E_APRED(NBP),  E_ADOC(NBP),   E_APOC(NBP),
E_CRESP(NBP),
```

```
     .     E_MICRZR(NBP), E_MESOZR(NBP),
E_MIC2MES(NBP),E_MICRZNP(NBP),
     .     E_MESOZNP(NBP), E_MICRZDOC(NBP),
     .     E_MICRZPOC(NBP),E_MESOZPOC(NBP), E_MICRZPR(NBP),
     .     E_MESOZPR(NBP), E_MICRZALG(NBP), E_MESOZALG(NBP)

      REAL E_UADOCSZ(NBP), E_UAPOCSZ(NBP),  E_UAPOCLZ(NBP),
     .     E_UADOCLZ(NBP), E_POC2DOC(NBP),  E_TCONLZ(NBP),
     .     E_TCONSZ(NBP)

      REAL COL_JDAY,         COL_ALGC,          COL_ANPP,
     .     COL_AGPP,         COL_APRED,         COL_ADOC,
     .     COL_APOC,
     .     COL_DOC,          COL_POC,           COL_DETC,
     .     COL_CRESP,        COL_POC2DOC,       COL_MICRZ,
     .     COL_MICRZR,       COL_MICRZNP,       COL_MICRZDOC,
     .     COL_MICRZPOC,       COL_MICRZPR,       COL_MICRZALG,
     .     COL_TCONSZ,       COL_UADOCSZ,       COL_UAPOCSZ,
     .     COL_MESOZ,        COL_MESOZR,        COL_MESOZNP,
     .         COL_MESOZPOC,       COL_MESOZPR,
COL_MESOZALG,
     .     COL_MIC2MES,       COL_TCONLZ,       COL_UADOCLZ,
     .     COL_UAPOCLZ

      REAL COL_BURIAL,        COL_CFLUX,        COL_ALG2SED,
     .     COL_BALG,          COL_BALGR,
     .     COL_BALGPR,        COL_BALGC,        COL_BNPP,

     .     COL_SAV,           COL_SAVNP,        COL_SAV2SED,

     .     COL_SAV2POC,       COL_SAV2DOC,       COL_SFEED,

     .     COL_SFNP,          COL_SFTCON,       COL_SFACON,

     .     COL_SFPCCON,       COL_SFUAC,        COL_DFEED,

     .     COL_DFNP,          COL_DFTCON,       COL_DFUAC,
     .     COL_SEDPOC,        COL_SEDR,         COL_SFR,
     .     COL_DFR,           COL_SAVR

      REAL REG_JDAY(10000),  REG_ALGC(10000),   REG_ANPP(10000),
     .     REG_AGPP(10000),  REG_APRED(10000),  REG_ADOC(10000),
     .     REG_APOC(10000),
     .     REG_DOC(10000),   REG_POC(10000),    REG_DETC(10000),
     .     REG_CRESP(10000), REG_POC2DOC(10000),REG_MICRZ(10000),
     .
REG_MICRZR(10000),REG_MICRZNP(10000),REG_MICRZDOC(10000),
     .
REG_MICRZPOC(10000),REG_MICRZPR(10000),REG_MICRZALG(10000),
     .
REG_TCONSZ(10000),REG_UADOCSZ(10000),REG_UAPOCSZ(10000),
     .     REG_MESOZ(10000), REG_MESOZR(10000),
REG_MESOZNP(10000),
     .
REG_MESOZPOC(10000),REG_MESOZPR(10000),REG_MESOZALG(10000),
     .
REG_MIC2MES(10000),REG_TCONLZ(10000),REG_UADOCLZ(10000),
```

```
     .     REG_UAPOCLZ(10000)

      REAL REG_BURIAL(10000), REG_CFLUX(10000),
REG_ALG2SED(10000),
     .     REG_BALG(10000),   REG_BALGR(10000),
     .     REG_BALGPR(10000), REG_BALGC(10000), REG_BNPP(10000),

     .     REG_SAV(10000),    REG_SAVNP(10000),
REG_SAV2SED(10000),
     .
REG_SAV2POC(10000),REG_SAV2DOC(10000),REG_SFEED(10000),
     .     REG_SFNP(10000),
REG_SFTCON(10000),REG_SFACON(10000),
     .     REG_SFPCCON(10000),REG_SFUAC(10000), REG_DFEED(10000),

     .     REG_DFNP(10000),   REG_DFTCON(10000),REG_DFUAC(10000),
     .     REG_SEDPOC(10000), REG_SEDR(10000),  REG_SFR(10000),
     .     REG_DFR(10000),    REG_SAVR(10000)

      REAL MICRBENALG_DOC,MICRBENALG_POC,MICRBENALG_SedPOC

      REAL V1(0:NBP), SFA(NSBP), JDAY

      INTEGER NB, NSB, SBN(NSBP), BBN(NSBP), CELL, B
      INTEGER NBOXCOL(NSBP), BOX(NSBP,NLP), REG_CELL(1000)

      CHARACTER*72 TITLE(6)

      LOGICAL SAV_CALC, BALGAE_CALC


      DATA KFL /21/

      end module kfl_mod




      module data_mod


      real  AREG_JDAY, AREG_ALGC, AREG_ANPP, AREG_AGPP,
     &      AREG_APRED, AREG_ADOC, AREG_APOC


      real AREG_DOC, AREG_POC, AREG_DETC, AREG_CRESP,
AREG_POC2DOC

      real AREG_MICRZ, AREG_MICRZR, AREG_MICRZNP, AREG_MICRZDOC,
     &     AREG_MICRZPOC, AREG_MICRZPR, AREG_MICRZALG,
AREG_TCONSZ,
     &     AREG_UADOCSZ, AREG_UAPOCSZ

      real AREG_MESOZ, AREG_MESOZR, AREG_MESOZNP, AREG_MESOZPOC,
     &     AREG_MESOZPR, AREG_MESOZALG,  AREG_MIC2MES,
AREG_TCONLZ,
     &     AREG_UADOCLZ, AREG_UAPOCLZ
```

```
      real AREG_BURIAL, AREG_CFLUX, AREG_SEDR, AREG_ALG2SED,
     &     AREG_BALG, AREG_BALGR, AREG_BALGPR, AREG_BALGC,
     &     AREG_BNPP

      real AREG_SAV, AREG_SAVNP, AREG_SAVR, AREG_SAV2SED,
     &     AREG_SAV2POC, AREG_SAV2DOC

      real AREG_SFEED, AREG_SFNP, AREG_SFR, AREG_SFTCON,
     &     AREG_SFACON, AREG_SFPCCON, AREG_SFUAC,
     &     AREG_DFEED, AREG_DFNP, AREG_DFR,  AREG_DFTCON,
     &     AREG_DFUAC, AREG_SEDPOC




      ! Production/Biomass ratio
      real PB_BALGRatio, PB_ALGRatio, PB_Z1Ratio, PB_Z2Ratio,
     &     PB_SAVRatio,  PB_DFRatio,  PB_SFRatio


      real APB_BALGRatio, APB_ALGRatio, APB_Z1Ratio,
     &     APB_Z2Ratio, APB_SAVRatio, APB_DFRatio, APB_SFRatio




      ! Consumption/Biomass
      real QB_Z1Ratio, QB_Z2Ratio, QB_DFRatio, QB_SFRatio
      real AQB_Z1Ratio, AQB_Z2Ratio, AQB_DFRatio, AQB_SFRatio



      ! Uassimulated/Consumption
      real UATC_Z1Ratio, UATC_Z2Ratio, UATC_DFRatio, UATC_SFRatio
      real
AUATC_Z1Ratio,AUATC_Z2Ratio,AUATC_DFRatio,AUATC_SFRatio


      ! Z1 Diet Compostion
      real Z1DCDOC, Z1DCPOC, Z1DCALG
      real AZ1DCDOC, AZ1DCPOC, AZ1DCALG


      ! Z2 Diet Compostion
      real Z2DCPOC, Z2DCZ1, Z2DCALG
      real AZ2DCPOC, AZ2DCZ1,  AZ2DCALG


      ! Deposit Feeders (DF) Diet Compostion
      real DFDCSedPOC
      real ADFDCSedPOC

      ! Filter Feeders (SF) Diet Compostion
      real SFDCPOC, SFDCALG
      real  ASFDCPOC, ASFDCALG
```

```
 ! Phytoplankton Detrital Fate
 real ALG_SedPOC, ALG_POC, ALG_DOC, AlgExport,  AlgTotal
 real AALG_SedPOC, AALG_POC, AALG_DOC, AAlgExport, AAlgTotal


 ! Microzooplankton Detrital Fate
 real Z1_SedPOC, Z1_POC, Z1_DOC, Z1Export, Z1Total
 real AZ1_SedPOC, AZ1_POC, AZ1_DOC, AZ1Export ,AZ1Total


 ! Mesozooplankton Detrital Fate
 real Z2_SedPOC, Z2_POC, Z2_DOC, Z2Export, Z2Total
 real AZ2_SedPOC, AZ2_POC, AZ2_DOC, AZ2Export, AZ2Total


 ! SAV Detrital Fate
 real SAV_SedPOC, SAV_POC, SAV_DOC, SAVExport,SAVTotal
 real ASAV_SedPOC, ASAV_POC, ASAV_DOC, ASAVExport, ASAVTotal


 ! Deposit Feeders Detrital Fate
 real DF_SedPOC, DF_POC, DF_DOC, DFExport, DFTotal
 real ADF_SedPOC, ADF_POC, ADF_DOC, ADFExport, ADFTotal


 ! Suspension Feeders Detrital Fate
 real SF_SedPOC, SF_POC, SF_DOC, SFExport, SFTotal
 real ASF_SedPOC, ASF_POC, ASF_DOC, ASFExport, ASFTotal


 ! DOC Detrital Fate
 real DOC_SedPOC, DOC_POC, DOC_DOC, DOCExport, DOCTotal
 real ADOC_SedPOC, ADOC_POC, ADOC_DOC, ADOCExport, ADOCTotal


 ! Sed POC Detrital Fate
 real SedPOC_SedPOC, SedPOC_POC, SedPOC_DOC,
&     SedPOCExport,  SedPOCTotal

 real ASedPOC_SedPOC, ASedPOC_POC, ASedPOC_DOC,
&     ASedPOCExport, ASedPOCTotal


 ! POC Detrital Fate
 real POC_SedPOC, POC_POC, POC_DOC, POCExport, POCTotal
 real APOC_SedPOC, APOC_POC,APOC_DOC, APOCExport, APOCTotal


 ! Microphytobenthos Detrital Fate
 real AMICRBENALG_SedPOC, AMICRBENALG_POC, AMICRBENALG_DOC,
&     ABAExport, ABATotal, AExport


 end module data_mod
```

REPORT DOCUMENTATION PAGE					*Form Approved* *OMB No. 0704-0188*

1. REPORT DATE *(DD-MM-YYYY)* August 2009	**2. REPORT TYPE** Final report	**3. DATES COVERED** *(From - To)*
4. TITLE AND SUBTITLE User's Guide to Linking the CE-QUAL-ICM and Ecopath Models		**5a. CONTRACT NUMBER**
		5b. GRANT NUMBER
		5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S) Carl F. Cerco, Dorothy H. Tillman, and Terry K. Gerald		**5d. PROJECT NUMBER**
		5e. TASK NUMBER
		5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Engineer Research and Development Center Environmental Laboratory 3909 Halls Ferry Road Vicksburg, MS 39180-6199		**8. PERFORMING ORGANIZATION REPORT NUMBER** ERDC/EL SR-09-1
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Corps of Engineers Washington, DC 20314-1000		**10. SPONSOR/MONITOR'S ACRONYM(S)**
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT
The present report is one of a series that documents research relating the coupling of spatially and temporally detailed eutrophication models with ecosystem models that lack spatial and temporal resolution. Specifically, the Corps of Engineers Integrated Compartment Water Quality Model (CE-QUAL-ICM) is coupled to the Ecopath with Ecosim (EWE) fisheries model. Previous reports in this series introduced the concepts necessary for communication between the two models and detailed the linkage. The previous linkage relied on a "human interface" between the two models. That is, information from CE-QUAL-ICM was printed and entered into the EWE input screen by hand. This process has been replaced by a graphical user interface (GUI), which is documented herein.

15. SUBJECT TERMS
CE-QUAL-ICM
Chesapeake Bay
Ecosystem models
Eutrophication models
EWE fisheries model

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT UNCLASSIFIED	**b. ABSTRACT** UNCLASSIFIED	**c. THIS PAGE** UNCLASSIFIED		73	**19b. TELEPHONE NUMBER** *(include area code)*

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. 239.18